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STAKMAN (E. C.). **The species concept from the point of view of a plant pathologist.**—*Amer. Journ. of Botany*, x, 5, pp. 239–244, 1923.

This paper is one of a series entitled 'The Utility of the Species Concept' and was originally read at the joint meeting of the American Association for the Advancement of Science, the Phytopathological Society, and the Botanical Society of America at Toronto on 28th December 1921.

The accurate description of species is of great practical importance to pathologists, since an exact knowledge both of host and pathogen is essential to the work of pathological research and experimentation. Pathologists are indebted to geneticists for the pure line conception, whereby many serious errors of interpretation regarding the pathogenicity and biologic specialization of a given parasite may be avoided.

The published descriptions of pathogenic fungi, which until recently were based primarily on morphological characters, frequently afford but little assistance to pathologists. As applied to fungi, the species concept seems to be based on the general underlying ideas (1) that all the individuals comprising a species are sufficiently alike morphologically to make it possible to differentiate them from individuals of other species by means of morphological characters; and (2) that the characters are relatively stable through successive generations.

The morphology of the fungus as a criterion of the essential similarity of individuals has been often misused. Temporary and accidental modifications have served as a basis for the multiplication of one true morphologic species into several imaginary ones. On the other hand, several distinct species have sometimes been described as one single species, either on account of faulty technique or an insufficiently wide range of observation. The character of growth, the reproductive capacity, and the morphology of the

organism may be profoundly influenced by the quantity and quality of available food and by environmental conditions. The pathologist is vitally interested in knowing the morphology of a pathogenic organism under all possible conditions, and is especially concerned as to whether essential morphological identity means also essential physiological identity, since in many species this relationship does not hold.

There is a growing tendency to use physiological characters as a basis for the delimitation of species in systematic work on fungi, since it has been shown that one so-called species may contain not only several morphological but also several physiological races (biologic forms, specialized races, chemical species, 'Gewohnheitsrassen', terms differing in degree rather than in kind and all termed biologic forms by the author). Such forms may be practically indistinguishable morphologically, while differing markedly from one another in their physiological action. Species of *Aspergillus* and *Penicillium* may be more easily recognizable by chemical than by morphological characteristics, and among pathogenic fungi, such as *Sclerotinia. Erysiphe, Puccinia graminis, P. coronata,* and others, similar differences also appear to exist. Whether the physiological differences between biologic forms can be detected on artificial culture media or only by the action of the forms on the host plants, the nature of the difference appears to be essentially the same, namely, physico-chemical.

The reason why biologic forms were not classified as distinct species when originally discovered was probably the supposed instability and plasticity of such forms. The writer and various colleagues, however, have failed in all their endeavours, extending over a period of ten years, to change the hereditary parasitic capabilities of such biologic forms as *P. graminis tritici, P. graminis secalis, P. graminis phleipratensis, P. graminis avenae, P. graminis agrostis*, and *P. graminis tritici-compacti.* These biologic forms are as constant genetically as are the species of wild and cereal grasses upon which they are cultured, provided that pure line races are used.

Many biologic forms differ from each other morphologically as well as physiologically. The forms of *P. graminis* which are separable on the basis of their action on different genera of host plants (in the United States) can be recognized by the size, shape, and colour of the uredospores, and by the size of the teleuto- and aecidio-spores, provided these spores are developed on hosts of the same approximate degree of susceptibility and in approximately identical environmental conditions. There is a consistent average difference of ten microns between the length of the uredospores of the *tritici* form and that of uredospores of the *agrostis* form. But even if no morphological differences existed, these biologic forms are distinct and constant and must be recognized.

Brierley has recently, [*Trans. Brit. Mycol. Soc.*, vi, p. 217, 1919] suggested that some such terminology as that of Lotsy [Evolution, 1916], proposed for the phanerogams, should be adopted to meet mycological requirements, and the principles involved in this plan, whether it be followed or not, are worthy, in the author's opinion, of serious consideration. The criticism that the recognition of

physiological characters in classification would be drawing too fine a distinction is met by the fact that the real distinctions were drawn by Nature, and have a practical importance in the case of pathogenic fungi.

COKER (W. C.). **The Saprolegniaceae with notes on other water molds.**—201 pp., 63 pl., Univ. North Carolina Press, 1923.

This fine volume contains a description of the known species of the family Saprolegniaceae, the genera described being *Pythiopsis*, *Saprolegnia*, *Aplanes*, *Isoachlya*, *Protoachlya* n. g., *Achlya*, *Thraustotheca*, *Dictyuchus*, *Leptolegnia*, and *Aphanomyces*. It also contains a list of the genera and species of the other families—Leptomitaceae, Monoblepharidaceae and Blastocladiaceae—of the order Saprolegniales, together with notes on a few of the parasitic Chytridiaceae observed in a living condition on water moulds.

All the species of these families seen by the writer in the living condition are admirably figured in full page plates, and the copious notes on distribution, habitat, and structure make the volume a mine of information indispensable to all students of the aquatic fungi.

No fresh light is thrown on the problem of the parasitism of members of this group on fish and other aquatic animals.

An extensive bibliography and an adequate index are appended.

PETCH (T.). **The diseases of the Tea bush.**—xii + 220 pp., 3 col. pl., 69 text-figs., London, Macmillan & Co., 1923.

The author deals with some sixty diseases of the tea bush, several of which are new in that they have not previously been discussed in a comprehensive survey; in other cases, a more complete study of the old diseases has revealed the fact that certain diseased conditions, due to several distinct causes, had been grouped under the same name.

Chapter 1 gives a short account of the classification of fungi, to be used, as stated in the preface, as a running glossary of the later chapters. Chapter 2 deals with leaf diseases. These assume a greater importance here than in almost any other crop, as tea is grown specifically for its leaves. Periodic spraying is considered bad practice, and the picking of diseased leaves has not had to be seriously tested. The experience of the Ceylon planters since 1900 is that leaf disease in general is best checked by well-balanced manuring and cultivation. Excessive nitrogenous manuring is held to be definitely harmful. Grey blight (*Pestalozzia theae* Saw.), known in Ceylon, India, Java, Formosa, and the Caucasus, was the earliest recorded tea-leaf disease, and at first occasioned considerable alarm. However, the opinion now, both in Ceylon and in India, is that under modern conditions of cultivation grey blight cannot be considered a dangerous parasite.

Brown blight (*Colletotrichum camelliae*) is known in Ceylon, Java, and India, and the author considers it more dangerous than grey blight, in that it is more prone to attack the young leaves. A leaf-margin disease has been described in Assam due to a combination of *Pestalozzia* and *Colletotrichum*, but the author is inclined to think that the former fungus was present saprophytically. Copper

blight (*Guignardia camelliae*) is common in India, Ceylon, and Java; the symptoms are scarcely distinguishable from those of brown blight, and the fungus is considered to be merely the perithecial stage of the *Colletotrichum*. Bird's eye spot (*Cercospora theae*) is quite common and is known from Java, Ceylon, and India. Leaf diseases so far recognized only in Ceylon include *Cercosporella theae*, *Phoma theicola*, and *Phaeosphaerella theae*; while *Exobasidium reticulatum* and *Gloeosporium theae-sinensis* have been reported only from Japan, and there are a number, unknown elsewhere, which have been described by Speschnew in the Caucasus.

Chapter 3 deals with combined leaf and stem diseases. Blister blight (*Exobasidium vexans*) has existed in Assam since 1868 and suddenly appeared in the Darjeeling district (India) in 1908; in 1920 it was recognized in Japan. It is not known elsewhere, and the problem of how it reached the other localities is not yet solved. The disease usually appears towards the end of April, and in May almost all the young foliage may be destroyed. Red rust (*Cephaleuros parasiticus*) has been known in India for a long time as a serious tea disease, and is now recognized as such in Ceylon and Java. The leaves are first attacked and later the branches. The disease is best met by cultivation and manuring. It is not yet certain whether the alga which attacks the old stems is *C. parasiticus* or an allied species, *C. mycoidea*, usually found on the leaves. Bacterial leaf and stem disease (*Bacillus theae*) is only known from Japan. Black rot (due to different species of *Corticium*) is a serious disease in Java and Ceylon; the Java species, *C. theae*, is distinguished from the Ceylon species [not named] by forming pinkish cords along the branches. The parasitic thread blight of India is only known as a sterile mycelium which bears 'anker' cells; it occurs in all Indian districts, but is now efficiently controlled by pruning and caustic washes. Corresponding parasitic thread blights are known in Java and Ceylon. The epiphytic thread blight of India and Ceylon is now known to be *Marasmius pulcher*; it does no appreciable harm, and the same may be said of the horsehair blight (*Marasmius equicrinis*).

Chapter 4 deals with stem diseases. A canker in India has been attributed to *Nectria cancri*; in Ceylon there is one due to *Macrophoma theicola*. *Corticium salmonicolor* has a range right through the tropics. A die-back occurs in North India caused by *Nectria cinnabarina*, another in Java caused by *Stilbella theae*, and two in Ceylon due to *Aglaospora aculeata* and *Massaria theicola*. *Irpex destruens* in Ceylon causes a 'stump rot', a name used to denote a decay which sets in from the top of the main stem in old bushes.

Chapter 5 deals with root diseases, and the author gives a key for the identification of the common forms. *Rosellinia arcuata* is the common *Rosellinia* disease of Ceylon, India, and Java. *R. bunodes* (rare in Ceylon) has the same distribution. Another *Rosellinia* disease has also been described from North India. *Ustulina zonata* is a frequent parasite throughout the tropics, and especially spreads to tea through the decaying roots of *Grevillea*, after use as a shade tree. *Sphaerostilbe repens* has been recorded as a parasite of tea in India, where it spread from *Artocarpus integrifolia*, while *Botryodiplodia theobromae* spreads especially

from old *Grevillea* stumps and buried prunings. Red root disease (*Poria hypolateritia*), well known in Ceylon, South India, and Java, is in Ceylon the most prevalent disease of young clearings, spreading especially from the jungle tree *Symplocos spicata*; while *P. hypobrunnea* is a similar disease, only so far known in Ceylon and spreading especially from *Tephrosia candida*. *Trametes theae* Zimm. in Java is perhaps identical with one of the last two. Brown root disease (*Fomes lamaoensis*) and *Fomes lignosus* are widely spread through the Eastern tropics, while *Fomes lucidus* has attacked tea roots in North India. *Fomes applanatus*, *Polyporus mesotalpae*, *P. interruptus*, and *Irpex subvinosus* in Ceylon, and *Armillaria mellea* in Java, are other fungi that attack tea roots.

The last three chapters deal respectively with wound covers, sprays and sprayers, mycological notes on a number of the fungi mentioned, and English diagnoses of the species recorded on the tea bush.

DETWILER (S. B.). **Spare the Currant and spoil the Pine.**—*Amer. Forestry*, xxix, 354, pp. 337–340, 4 figs., 1923.

This is a popular account of the distribution and life-history of white pine blister rust [*Cronartium ribicola*], and of the legislative and other measures adopted for its elimination.

Excellent results are stated to have been accomplished by the blister rust control agents appointed by the Bureau of Plant Industry in New York, Wisconsin, and Minnesota [see this *Review*, ii, p. 205]. The area cleared of currants and gooseberries in 1922 was 22 per cent. larger than in 1921, and the cost per acre less. During the past field season 472,887 acres in the eastern States have been cleared at a cost of less than 20 cents per acre, and the white pine growing on this area is considered to be safe from blister rust for another five to ten years.

The money spent by towns and individuals on control work increased from $19,000 in 1921 to over $45,000 in 1922. Certain New England banks require the destruction of currants and gooseberry bushes within 900 feet of the pine before advancing money on farms with white pine stands. In Washington, Oregon, Idaho, and Montana the campaign against blister rust has also been vigorously prosecuted. In British Columbia the disease, which was first observed in the autumn of 1921 [see this *Review*, ii, pp. 107, 253], is of unprecedented severity.

SCHELL (E.). **Diseases of the French Chestnut tree—particularly the 'ink-malady'.**—*Journ. Amer. Leather Chem. Assoc.*, xvii, 7, pp. 353–359, 1922.

Penicillium glaucum and *Aspergillus niger*, together with the larva *Carpocapsa splendana*, cause an annual loss of nearly one-third of the French chestnut crop. The nuts are also attacked by black rot (*Racodiella castaneae*), the ascigerous form of which is believed by Peyronel to be identical with *Sclerotinia pseudotuberosa* on acorns. The wood is attacked by *Diplodia castaneae* and a species of *Coryneum*, and the roots by *Agaricus melleus* [*Armillaria mellea*] and *Hypholoma fasciculare*.

By far the most important disease, however, is the so-called 'ink malady', which has completely ravaged the forests of the Pyrenees and caused considerable damage in other regions also to public and private property. The following account is based on a report drawn up in 1918 by the well-known mycologist, G. Couderc, who is engaged on a systematic investigation of the disease and the possible methods of control.

The first external symptom is the fall of the male catkins without blossoming, followed, in July, by an intense yellowing of the abnormally small leaves. The death of the affected trees ensues in two years or less on poor soil, and in four to five years on rich, well-fertilized ground.

The essential characteristic of the ink disease, however, is the decay of the roots, originating in the depths of the soil, which, once infected, becomes a deadly medium for young trees or seedlings. When the infected soil is dug up for a depth of 70 to 80 cm. the replanted chestnuts at first grow vigorously, but succumb towards their fourth or fifth year owing to the decay of the tap-root or other large roots.

The violet or yellowish-black exudation at the base and on the largest roots, which suggested the popular name for the disease, is not a constant symptom, being dependent on the soil and the season. Young trees, especially, may show little, if any, of this flux. Much more universally characteristic of the disease is the rapid and continuous march of the epidemics which it produces, in contrast to the insidious attacks of other parasites, e.g. *Armillaria mellea*.

An exhaustive study of the disease and of the literature bearing upon it has persuaded Couderc that the fungus *Mycelophagus castaneae* [see this *Review*, ii, p. 188] is almost certainly the causal agent. Longitudinal sections through the roots of young diseased trees reveal the presence of an extremely fine mycelium about 1 μ in diameter, varicose, hyaline, roughened, and much ramified, with short branches terminating in the interior of the cells in coralloid clusters, which appear to act as haustoria. This mycelium is connected with rhizoids, of a dirty, yellowish-white colour on drying, which run to the surface of the bark, and have apparently non-septate, varicose hyphae. The coralloid extremities of the mycelium strongly resemble large, coccus-like bacteria. The fungus could not be induced to fruit in culture.

In boiled water cultures, however, dark brown sclerotia of very irregular shape are observed in the diseased bark, apparently in connexion with the mycelium. These sclerotia have not been observed in nature, probably because of the numerous sclerotia arising from the mycorrhiza. They are believed, however, to represent the organs of conservation of the fungus in the depths of the soil, thereby accounting for the permanence of the disease in contaminated soils. Mangin's theory of the parasitism of the mycorrhiza is not accepted.

M. castaneae appears to be an Oomycete, but its true organs of fructification are still uncertain. It thrives best in an anaerobic medium, for it has been noticed that the last trees to survive the disease are situated on the edges of terraces where the roots have

only a shallow covering of soil and are consequently fairly well aerated.

Various measures of control have been tested. The sterilization of the soil with sulphate of iron, successfully applied to vines attacked by *Phylloxera*, has been proved feasible but extremely difficult owing to the great depth of the roots and their distance apart. Treatment with sodium nitrate has given good results on a small scale, but is scarcely applicable to extensive areas.

In view of these difficulties considerable attention is being given to the possibilities of grafting and hybridization. Grafting on indigenous oaks, which are entirely immune from the disease, has not given the anticipated results, but the chestnut-leaved Algerian oaks and the Indian *Castaneopsis* still remain to be tried. The Tambu Japanese hybrid chestnut has been cultivated at Ardèche and appears to be very resistant to the disease. Couderc's plan is to select for contaminated soils a wild form of Japanese chestnut which should eventually serve as graft stock for the indigenous varieties. It must be remembered, however, that the Japanese chestnuts are liable to attack by *Endothia parasitica*, which might develop into an even more serious disturbance than the ink malady.

DUFRÉNOY (J.). **Les maladies du châtaignier.** [The diseases of the Chestnut.]—*Compte Rendu du Congrès Régional à Brive*, pp. 45–63, 13 figs., 1922.

The 'ink' disease of chestnut trees [see this *Review*, ii, p. 188, and last abstract] is primarily a disease of the root, which progresses centripetally towards the main roots and the collar. It shows itself under widely varying aspects, no really specific and general character permitting of its ready identification. The first symptom—the death of the rootlets—is not immediately reflected in the aerial portion of the tree, but growth is slowed down, and the foliar internodes become shorter whilst the annual rings become thinner. Chlorosis of the leaves may also occur at this stage, or may be deferred till later. Sometimes it is only partial, especially in cases of grafting, when the foliage produced by one scion may develop yellowing, the remainder keeping green. A little later the crown of the tree loses many leaves, which gives it a characteristic partly defoliated appearance. Young trees planted in infected soil, which manage to survive, are so retarded in growth as to suggest 'nanism'. The fruits become smaller and smaller as the disease progresses, and some of them are found to be abortive before maturity, the envelopes remaining attached to the branches for a period extending over several seasons. Later on, no more female flowers are formed, while the male flowers, which become shorter and shorter and produce no pollen, dry up and remain attached to the branches, when death from 'apoplexy' supervenes in July–August. The root system, meanwhile, throws out lateral rootlets to replace those destroyed by the disease. Of these, many are attacked by the mycorrhizal fungi, while others elongate and develop a thick cortical parenchyma. The invasion of the roots starts from lesions, which are apparently of traumatic origin, being probably caused by grubs.

As soon as the rotting of the rootlets has reached their point of attachment to the larger roots, cankers are formed and may penetrate even into the woody layers. The root lesions have the appearance of ink-stains, and the bark at these places is depressed. They correspond to brown stains in the cambium, underneath which a wet rot is found. The invaded roots tend to localize the lesions by the production of several layers of cork on the margin of the healthy tissues. In bad cases the cambium transforms itself into a suberous layer. Unable to obtain its food through the decayed root system, the tree withers and dies. The more abundant the foliage the greater are the demands made on the roots, and therefore the more rapid is the development of the disease. Severe pruning of the branches not only retards it, but facilitates the formation of fresh roots. This operation, however, can only be of use in recently infected cases, before the main roots and the collar are affected. Individual trees have sometimes been known to resist the disease though surrounded by dead and dying trees, but whether this is due to individual powers of resistance or to other more fortuitous causes, such as irregularities in the infection of the soil, is not known. Japanese and Chinese varieties, which are supposed to be immune, are now being tested, the greatest care being taken to avoid introducing the fungus *Endothia parasitica*, which has so far not been reported in France.

Several fungi are found in the diseased roots. The first of these—*Armillaria mellea*—may apparently cause root rot independently. Another is *Coryneum kunzei* var. *castanea*, which also is able to invade healthy roots. *C. perniciosum* (= *C. modonium* [*Melanconis modonium*]), which is claimed by Briosi and Farneti to be the cause of the 'ink' disease, causes a disease, the symptoms and rapid evolution of which have some similarity with those of the 'ink' disease, but the author is of opinion that the two have nothing else in common, the more so as *C. perniciosum* is not always present in cases of 'ink' disease, and vice versa. *Diplodina castaneae* causes the death of shoots from the second growth by attacking the collar. The alterations produced by these last three fungi are quite distinct from those due to the 'ink' disease.

The latter's geographical distribution in the Corrèze Department is fully traced and stated to include the districts west of Tulle.

In the early stages of the disease a solution of sulphate of iron (3 kg. crystallized sulphate of iron dissolved in 10 litres of boiling water) may be applied, when cool, to the roots. In the autumn or winter sulphate of iron may be laid on the soil immediately surrounding the tree in stronger doses, say 1 kg. per sq. m. Permanganate of potash is also useful in concentrated solutions, the quantity to be applied being 5 litres per sq. m. Disinfection of the soil with carbon bisulphide or calcium sulphide, while keeping fungous growth in check, also prevents the approach of grubs, the lesions from which may be the starting-point of the disease.

[In a recent letter to this Bureau the author states that his views on the 'ink' disease have altered considerably since this paper was written, as a result of finding a mycelium of the Peronosporaceous type in the root lesions described. These developments are to be described by him in subsequent publications.]

ALTONA (T.). **Kernrot in Tectona grandis L.f.** [Heart rot in *Tectona grandis* L.f.]—*Tectona*, xvi, 5, pp. 456–473, 15 figs., 1923. [English summary.]

Towards the end of 1922 the author observed in the forests of Bodjonegoro (Java) the symptoms of a teak [*Tectona grandis*] disease which appears to be widespread. Affected trees have withered tops and bear numerous adventitious buds, whilst many vertical and horizontal clefts appear in the bark. The cause of the disease is probably a fungus which gains admission to the tree through the wounds inflicted by birds, insects, fire, or the stripping off of the foliage. The infection spreads downwards and laterally, causing a dark brown discoloration of the heart wood. The healthy and diseased wood are separated by a dark band.

The economic effects of the disease on the trees cannot yet be estimated, but there is some reason to hope that, with advancing maturity, the trees may exhibit greater resistance. Among the species found to be similarly affected were *Butea frondosa*, *Swietenia mahagoni*, *Acacia leucophloea*, *Pithecolobium saman*, *Cassia siamea*, *Tamarindus indica*, *Albizzia lebekkoides*, *Grewia celtidifolia*, *Leucaena glauca*, *Erioglossum edule*, and *Allophylus cobbe*.

The examination of the diseased material revealed the presence in the heart wood of very fine, ramified hyphae, 1 to 2 μ in diameter, with granular contents.

It is highly probable, though not certain, that this fungus, which has not yet been identified, is responsible for the symptoms described above. Pending further investigations the only control measures which can be recommended are wide planting, early thinning out, and general attention to cultural practices.

JØRSTAD (I.). **Hvorledes skal man bekjaempe klumproten paa vore Kaalvekster?** [How is the prevention of club-root on Cabbages to be accomplished?]—*Norsk Havetid.*, xxxix, 8, pp. 126–127, 1923.

Club-root of cabbage (*Plasmodiophora brassicae*) has been very prevalent in Norway [during 1923] especially on unlimed soil. The disease may be suppressed to some extent by the application of lime or marl, and by allowing 5 to 6 years to elapse before cultivating *Brassica* crops on the same ground. The selection of resistant varieties, e. g. the Danish kohlrabi Studsgaard Bangholm, is an important step towards the eradication of the disease. Acid fertilizers should be avoided and organic manure sparingly applied. For the disinfection of frames 10 l. of formalin (1 in 40) per sq. m. should be used. The treated soil should be covered with sacks for two days and then ventilated for another eight to ten days.

The period of viability of the parasite in the soil is estimated at 7 to 8 years.

SALMON (E. S.) & WORMALD (H.). **The 'ring-spot' and 'rust' disease of Lettuce.**—*Journ. Min. Agric.*, xxx, 2, pp. 147–151, 3 figs., 1923.

The examination of a number of diseased lettuce plants from Swanley, Kent, in December 1922, revealed the presence of the fungus *Marssonia panattoniana* on an epidemic scale, threatening

the very existence of the lettuce-growing industry. The infected plants were so severely attacked as to be rendered quite unsaleable. The two common fungi *Botrytis* [*cinerea*] and *Bremia lactucae* were also present, but the damage caused by them was relatively inconsiderable.

Leaf blades and stalks are both attacked, the former showing characteristic perforations surrounded by a white line. The infected areas first appear as brown, water soaked spots, which soon become white with the spores of the fungus. On reaching a diameter of about one-eighth of an inch the central dead portions drop out. The name 'ring disease' is suggested as suitable for this type of injury.

On the midrib of the leaf the spots become elongated and form elliptical, brown, sunken patches. At these points the superficial layers of cells are killed and turn a rusty brown, and the consequent disfigurement of the leaves greatly depreciates the market value of the plant. The term 'rust' is proposed for this type of damage.

The varieties attacked were Trocadero, Lobjoit's Green, and Hardy White Winter Cos, grown on well drained loam soil. The owner of the affected plants attributes the infection to the use of London market refuse for fertilizing. These sweepings probably contained fragments of diseased lettuces imported from the Continent, where the trouble is known to occur.

The disease has only once been reported to occur in England, namely, on French forcing lettuces in a greenhouse at Haslemere, Surrey, but was recorded in various parts of Europe and the United States at different dates between 1894 and 1913. The Kent outbreak is the first occasion on which *M. panattoniana* is known to have occurred in the open.

No measures for the prevention or control of the disease have yet been devised in England, but foreign investigators recommend crop rotation and the early removal from the beds of diseased plants. Watering should be carried out in such a way as to prevent the splashing of the water from leaf to leaf or plant to plant, and manure containing lettuce refuse should not be used. The spraying of young plants with Bordeaux mixture or ammoniacal copper carbonate has been recommended, but nowhere apparently has it been practised.

PÖTSCHKE (A.). **Ueber das Schwarzwerden des Meerretticks.** [On the black discoloration of Horse-radish.]—*Arb. Biol. Reichsanst. für Land- und Forstwirtsch.*, xi, 4, pp. 337–338, 1923.

A disease of the vascular system of the stems of horse-radish, the principal external symptom of which is a dark brown to black discoloration of the stalks, is of frequent occurrence in Germany and Denmark in fields where the crop has been grown for too many years in succession.

Microscopic examination showed that affected vessels may occur singly or in large or small groups. In cases of early infection the diseased tissue may be separated from the healthy part of the plant by a phellogen layer. Different parts of the stem may be attacked with varying intensity. Severe cases are sometimes accompanied

by a premature withering of the leaves. The vessels were often observed to be obstructed with gum or tyloses.

A fungus was isolated in pure culture on slightly acid beerwort agar, and identified by the white mycelium, the two- to three-verticillate conidiophores, the conidia measuring 6 by 2 μ, and the chlamydospores, as a species of *Verticillium* differing in certain minor respects from *V. albo-atrum*. The maximum, optimum, and minimum temperatures for growth were 33° to 37° C.; 28° C.; and 5° to 10° C. respectively. Laboratory and field inoculation experiments gave positive results. Investigations and experiments which are not described in detail indicated that under natural conditions the fungus probably enters the plant through wounds.

Departmental Activities: Botany.—*Journ. Dept. Agric. S. Africa*, vi, 6, p. 480, 1923.

Peanut [*Arachis hypogaea*] plantations in the Waterberg, and to some extent in the Pietersburg and Rustenburg Districts, have been found to be affected with a disease, which is new to South Africa and appears to be unknown in other countries. The symptoms are: stunted growth, a deficiency of chlorophyll, a shortening of the internodes, and an abnormal proliferation of leaves and branches, giving the plants a rosette appearance. The yield in nuts is extremely reduced and in severe cases practically nil. The cause of the trouble is as yet unknown, as attempts to find a causal organism have failed; the matter is, however, still under investigation. Unless the disease is checked, it is likely to prove a serious menace to the industry.

Report on the Department of Science and Agriculture, British Guiana, for theyear 1921, 68 pp., 1923.

Owing to the ravages of the Pará rubber leaf disease (*Melanopsammopsis ulei*) and the consequent abandonment of extensive areas under *Hevea* [see this *Review*, ii, p. 354], the export decreased from 20,384 lb. in 1920 to 1,568 lb. in 1921.

Bud rot of coco-nut palms, believed to be due to defective drainage, continued to be much in evidence on the low-lying 'pegassy' lands in the north-western district.

The 'witches' broom' disease of cacao [*Marasmius perniciosus*], which was also prevalent, may be controlled by strict attention to cultural measures and by the application of Bordeaux mixture immediately after pruning.

Except for *Marasmius* root disease the sugar-cane plantations were relatively healthy.

Citrus plants were attacked by collar rot [cause not specified] and citrus knot [? *Sphaeropsis tumefaciens*].

Adams (J. F.). **Plant diseases and their prevalence for 1922 in Delaware.**—*Delaware School of Agric. Stencil. Circ.*, 1, 22 pp., 1923. [Mimeographed].

The following are some of the more interesting references in this report. On apples, scab (*Venturia inaequalis*) was very prevalent. Experiments in Sussex County showed that the ascospore discharge began on 28th March and continued till 1st June. In Kent County

it started on 18th April and continued till 26th May. The amount of infection appeared to be reduced by turning under the fallen leaves in early ploughing. The period of the calyx spray application was observed to be a critical time for the protection of the fruit. Blotch (*Phyllosticta solitaria*) reappeared in epidemic form after three years' comparative quiescence. Bordeaux mixture 4–4–50, applied one, two, and three weeks after petal fall, controlled the disease on the Duchess variety. For late varieties two additional applications, four and six weeks after petal fall, are important. Apple rust (*Gymnosporangium juniperi-virginianae*) was very prevalent and severe, especially on the Rome Beauty and Jonathan varieties, prematuring of the leaves and fruit being observed in many cases. The destruction of the red cedar [*Juniperus virginiana*], the winter host of the fungus, in the vicinity of orchards is essential. Fruit spot (*Phoma pomi*) and sooty blotch and fly speck (*Leptothyrium pomi*) were very prevalent in orchards where the second codling moth spray was omitted.

Double blossom (*Fusarium rubi*) and anthracnose (*Gloeosporium venetum*) of blackberries were very prevalent. *G. venetum* also attacked raspberries, and the latter were much affected by 'yellows'.

Grapes were severely attacked by black rot (*Guignardia bidwellii*) which resulted in a complete loss of the crop when spraying was omitted. Ripe rot (*Melanconium fuligineum*) caused severe damage to the Niagara and Agawam varieties.

The most important disease of peaches was bacterial shot hole (*Bacterium pruni*), which frequently resulted in 50 to 75 per cent. of defoliation, especially on the Elberta and Hale varieties. Plums were also affected. Infection was most serious during May and June. The best control of the disease was given by spring and summer applications of nitrate of soda at the rate of 2 lb. per tree.

Pears were severely attacked by leaf blight (*Fabraea maculata*), which may, however, be controlled by the application of Bordeaux mixture. Early defoliation of quinces from the same disease was common.

Asparagus rust (*Puccinia asparagi*) showed an increase in severity since the previous year. The cultivation of the resistant Washington variety and spraying with Bordeaux mixture or dusting with sulphur are recommended.

Cabbage yellows (*Fusarium conglutinans*) was very prevalent in Kent and New Castle counties. The New Brunswick and All Seasons varieties maintained their reputation for resistance. Black rot (*Bacillus campestris*) and blackleg (*Phoma oleracea*) were prevalent and severe, especially the former.

The control of downy mildew of the cantaloupe, caused by *Peronospora* [*Pseudoperonospora*] *cubensis*, by dusting with copper-lime-arsenate was not satisfactory, although the general condition of the vines was much improved by the treatment. Losses amounting to nearly 40 per cent. of the normal crop were experienced. Mosaic is becoming increasingly serious, the Rocky Ford and Pearl Pink varieties being affected.

The treatment of sweet potatoes with inoculated sulphur proved very effective in the control of pox or soil rot (*Cystospora batata*),

which was most destructive in certain sections; and of soil stain or scurf (*Monilochaetes infuscans*). In the latter case the sulphur was applied at the rate of 200 to 400 lb. per acre.

Maize was attacked by root and stalk rots caused by *Gibberella* and *Fusarium* spp. Seed selection by germination gave an increased yield of 2 to 25 bushels per acre compared with unselected seed. Black ear rot (*Diplodia zeae*) was much more prevalent than in the previous year, and inoculation experiments under field and greenhouse conditions proved the fungus to be an active parasite. Topping the maize appears to render it more susceptible.

Considerable interest attaches to the unusual prevalence of powdery mildew of clover (*Erysiphe polygoni*) during the past two years. In 1921 it appeared previous to harvesting and in 1922 on the secondary growth after cutting. Yellow spot of the cowpea (*Cercospora cruenta*), though less prevalent than usual, is regarded as being probably of greater importance than is generally realized.

Leaf spot of soy-beans (probably caused by *Bacillus lathyri*) was prevalent, while considerable damage resulted from a non-parasitic condition known as chlorosis or yellow leaf. The disturbance was found to be associated with food requirements, especially deficiency of potash.

Thirty-fourth Annual Report Kentucky Agricultural Experiment Station for the year 1921, 50 pp., 1922. [Rec'd 1923].

This report contains the following references to subjects of phytopathological interest.

The testing of strains of White Burley tobacco resistant to root rot [*Thielavia basicola*] has been continued. Six of the strains previously reported as resistant [see this *Review*, ii, p. 37] have been tested further on diseased soil and again exhibited a high degree of resistance. They have also proved more desirable than the varieties commonly grown, being earlier and more uniform in growth and type. Two new selections of Vimont Kelley were tested on diseased soil and found to be practically immune.

The relative resistance of maize varieties to root rot (*Fusarium moniliforme*) was determined by growing seedlings of each ear in a sand box in a warm room. The dates of death of the seedlings of each ear indicated their relative resistance to the fungus, which appears to be carried in sufficient quantities in all ears to infect the seedlings. No increase in yield in the field was obtained by selection, with the aid of the sand box, of the eleven most resistant ears from over a thousand ears, when these were compared with the six most susceptible ears from the same lot of maize (Boone County White).

Investigations upon the non-heading of lettuce have been continued, the varieties used in the work being Hanson, Hothouse, Hittinger's Belmont, and New York. The progeny of the selected individuals from those plants which headed in the greenhouse in the winter of 1920–21 were planted in the field in the spring of 1921 and in the greenhouse in the following autumn. Marked differences in the extent of heading were observed, not only

between the various strains but also among the individual plants within a strain. The results indicate that progress may be expected by continual selection. All plants grown in steam sterilized, formalin sterilized, and baked soil, and in sterile washed sand to which a nutrient mineral solution was applied, have shown a considerable amount of root rot and eventually developed tipburn. The best results so far obtained occurred on soil composted from sod and manure drenched with formalin, and in virgin bluegrass soil from which the surface layer of sod had been removed. Well-formed, solid heads developed from all plants grown on such soils, but subsequently tipburn and root rot occurred in every case. When grown on a soil composted of sod and manure and not treated with formalin, less than 50 per cent. of the plants headed. It can be definitely stated that the methods of soil sterilization used in these experiments influenced in a marked degree the factors contributing to non-heading. The results of experiments with Grand Rapids lettuce, a standard loose-leaf variety, were similar to those described above. Results hitherto obtained appear to indicate that the cause of root rot and the associated disease, tipburn, is a seed-borne organism which may be prevalent in garden soils and refuse, but apparently not in virgin soil.

A condition resembling the lettuce disease was noted in Chinese cabbage grown in the greenhouse during 1920–21. The plants were vigorous and grew normally for some time, the outer leaves attaining their full size. The central leaves, however, became stunted and the heads failed to develop. At the same time severe tipburn occurred on the inner leaves and on some of the outer ones. Eventually the central axis elongated and seed was produced. The smaller rootlets were found to be badly rotted. Chinese cabbage sown in July and transplanted to the field in August produced normal heads with no sign of tipburn.

An attempt was made to eliminate mosaic disease from affected strains of potatoes. The tubers were numbered and a small seed piece cut from each for spring planting, the remaining portions being placed in cold storage for planting in the autumn for the production of seed stock. Ten strains, including six varieties, were tested, using 100 tubers of each strain. The percentage of mosaic varied from 2 to 95 per cent. in the ten lots. The records obtained from the numbered plants in the field facilitated the elimination, from the corresponding numbered seed pieces held in cold storage, of all those with unfavourable prospects. The stored pieces of healthy tubers were planted on 26th July and showed no signs of mosaic throughout their growth period. The progeny of these will be further tested, in the hope that this method may prove a valuable means of securing improved disease-free seed stock.

A brief investigation was made of the keeping qualities of sweet potatoes grown under various cultural conditions. When the haulms were cut away before frost, only 4 per cent. of the sweet potatoes spoiled after storage at 60° to 85° F. When the haulms were cut away immediately after a frost no loss occurred, but if left for five days the loss amounted to 88 per cent. Sweet potatoes badly affected with soil stain (*Monilochaetes infuscans*) but other-

wise sound sustained a loss of 55 per cent., while healthy controls were reduced by 12 per cent. Sweet potatoes wrapped in paper sustained a loss of 20 per cent. as against 12 per cent. in those unwrapped.

ROBINSON (W.) & WALKDEN (H.). **A critical study of crown gall.**—*Ann. of Botany*, xxxvii, 146, pp. 299–324, 2 pl., 4 figs., 1923.

In this work, the development of galls of *Chrysanthemum frutescens* resulting from inoculation with *Bacterium tumefaciens* (isolated by Walkden in 1920) has been studied from the time of inoculation until the galls attain a large size, a strict comparison being made with control stems. Erwin Smith's work on secondary tumours and tumour strands, both on *C. frutescens* and *Nicotiana affinis*, has been critically repeated by the authors, and they have obtained galls similar in all respects to the primary and secondary galls figured by Smith, but their explanation, based on experimental evidence of the origin of the secondary galls and tumour strands, diverges completely from that given by him.

For the study of the development of galls after the inoculation of cut surfaces of stems, well-grown plants of *C. frutescens* grown in a temperate greenhouse were used, shoots as nearly as possible similar being selected for inoculation as controls.

When the cut surfaces, either of the upper ends of shoots in air or of the lower ends of cuttings in the soil, are inoculated, galls arise and grow rapidly, somewhat more rapidly in the former case than in the latter.

Three days after inoculation it is evident that the bacteria have invaded the open ends of the vessels, of the sieve-tubes, of the young pericycle fibres, and to some extent also the intercellular spaces of the cortex. Within six days of inoculation, the abnormal cell-divisions leading to gall formation have commenced. After nine days the influence of the organism has extended laterally into the cortex and the pith, and after fifteen days bacteria may be found in the intercellular spaces of the cortex some distance from the surface, and may give rise to centres of disturbance around which gall tissue develops. The maximum distance to which bacteria may extend, either along the vessels or intercellular spaces, is about 2 mm. At this age, while some of the proliferating cells continue to be meristematic, others become transformed into tracheid-like cells with characteristic reticulate or pitted markings. After four to five months the galls are more or less hemispherical in shape, there is a distinct zone of meristematic gall-cells arching over the end of the stem, and parenchymatous cells are developed externally to this. As the gall increases, the outer layers of this cortical region are continuously torn apart, the layer of dead cells being very marked in older galls. There is, however, no cork formation, and vast numbers of *B. tumefaciens* are found upon the layers of dead cells on the exterior. The increase in the size of the gall, in the later stages at least, seems to result from the presence of the causal bacteria in this position.

The position of the bacteria on the outside of the gall accounts for the difficulty found by other workers in isolating the organism

from the interior of the galls or from galls sterilized by mercuric chloride. Plating experiments are described which show that there are enormous numbers of bacteria on the exterior of actively growing galls of *C. frutescens*, that a high percentage of these are *B. tumefaciens*, and that it is reasonable to assume that their presence, in increasing numbers, provides the stimulus which leads to the continued growth of the gall.

In view of these results the authors studied the formation of secondary tumour strands both on *C. frutescens* and *N. affinis*. In the former host it was not possible to obtain secondary galls at a distance from the primary inoculation by inoculating the shoot at some distance from the growing point, but successful results were obtained by inoculating in the vicinity of the meristematic apex. A figure is given of a plant five weeks after being inoculated at the apex of the shoot, in which six galls at the bases of leaves were widely separated from each other by one or more internodes. A phyllotaxy diagram of the shoot shows that the position of the galls on the various leaves is consistent with all the galls having resulted from a single, horizontal needle prick. Similar results were obtained in numerous other cases. In a number of cases, however, smooth galls of a different appearance were obtained at a distance from the larger rough galls. Such galls are similar to many of Smith's secondary tumours, and are regarded by the authors as true secondaries. *B. tumefaciens* was never found on the exterior of such galls, and there was considerable difficulty in isolating the organism from the interior, but this was done in two cases. The bacteria were demonstrated in the protoxylem vessels and in the adjoining intercellular spaces of such galls, and continuity of the organisms was traced from them to the primary gall which arises where the inoculation wound is made.

Secondary galls arise around definite centres of bacteria, and the authors found no evidence of any invasive growth of tumour tissue from a distance.

Parallel studies were made on *N. affinis*. The organism was demonstrated in the interior of the secondary galls of this plant; it was isolated in large quantities; and the infective migration of the bacteria from the original point of infection for very considerable distances through the plant was traced. Definite zoogloeal strands of *B. tumefaciens* were seen advancing through a large, longitudinal intercellular space in the pith of *Nicotiana*, and such strands are invariably found in young secondary tumours of *N. affinis* and have also been frequently observed in *C. frutescens*, in which, however, the intercellular spaces are smaller and less abundant.

The bacteria also enter the protoxylem of both infected leaves and shoots, and travel in these vessels and are also passively carried up by growth extension, thus serving as centres for secondary tumours. The fact that the bacteria are restricted to the protoxylem in the secondary galls on *C. frutescens*, and that they are never so abundant as in *N. affinis*, explains the difficulty experienced in isolating the organism from the former. In the latter host the secondary galls and tumour strands frequently burst out to the

exterior, and the rough surfaces which they then acquire are richly populated with *B. tumefaciens.*

The authors have obtained no evidence of the growth of strands of tumour tissue to any distance at all comparable with that postulated by Smith. The tumour strands are in no real sense intrusive growths of tissue, but are the result of an intruding growth of bacteria in the intercellular spaces and along the protoxylem.

In discussing their results the authors point out there is no necessity to assume the stimulation of cells at any considerable distance from the bacteria, and they dissent from the close comparisons which have previously been made between crown gall and malignant tumours, particularly those of Smith with respect to the radial stem-like structure of the secondary galls on the leaves of *C. frutescens.*

A bibliography of 35 titles is appended.

MUDD (S.) & WARREN (S.). **A readily cultivable vibrio, filterable through Berkefeld 'V' candles, Vibrio percolans (new species).**—*Journ. of Bact.*, viii, 5, pp. 447–454, 1 pl., 1923.

A new vibrio, which has proved useful in testing various factors in filtration, was isolated in 1921 from the filtrate from hay infusion made from fresh water near Boston [U.S.A.] and named *Vibrio percolans.* This organism passes readily through Berkefeld 'V' candles impervious to *Erythrobacillus prodigiosus* and *Vibrio comma.* It is readily cultivable on hay infusion (approximately neutral reaction), bouillon, Witte's peptone, gelatine, and potato agar at a temperature of about 30° C., is actively motile, comma-shaped to straight, with rounded ends, 1·5 to 1·8 by 0·3 to 0·4 μ, occurring singly or in short chains, and having one or more polar flagella, 3 to 7 μ in length.

Further morphological and cultural characters are described and also its manner of progression, viability, non-pathogenicity, and thermal relationships.

MUDD (S.) **The penetration of bacteria through capillary spaces. I. Motility and size as influencing filterability through Berkefeld candles.**—*Journ. of Bact.*, viii, 5, pp. 459–477, 2 pl., 1923.

Cultures of *Vibrio percolans* [see preceding abstract], grown in hay infusion with an approximately neutral reaction, when brought into a hydrogen-ion concentration of P_H 5·3, or above, rapidly lose motility. Such non-motile cultures gave negative filtrates with Berkefeld 'V' candles through which the motile vibrios passed readily. The filterability of *V. percolans* was totally suppressed five times and partially suppressed five times by inhibiting its motility by ether, chloroform, or chilling. In all cases the viability of the non-motile culture was proved by positive subcultures. *Erythrobacillus prodigiosus,* which was growing with *V. percolans,* did not appear in any of the filtrates.

Motility is thus shown to be a critical factor in determining the passage of an organism through the irregular capillary bed. Probably it assists passage both in purely mechanical ways and by

combating the tendency of the organisms to adhere to the pore walls.

V. percolans failed in ten attempts to pass through Berkefeld 'N' candles; *V. comma*, while unable to pass through the 'V' candles pervious to *V. percolans*, passed more rapidly than the latter through a layer of 10 cm. of quartz sand. Its inability to pass through the 'V' candles is referable, therefore, not to inferior motility but to its dimensions being slightly larger than those of *V. percolans*.

Sections of a Berkefeld 'V' candle used for the filtration of *V. percolans* have been ground down to microscopic thinness and the vibrios stained and demonstrated in the interstices between the silicious granules of the filter substance. The intergranular diameters are therefore of critical importance in determining the penetrability of the filters by bacteria.

That the relative numbers and sizes of the pores may also be of critical significance is shown by the successful passage of motile vibrios through 'V' filters and their failure to pass 'N's'.

Bergey's Manual of Determinative Bacteriology: A Key for the identification of organisms of the class Schizomycetes arranged by the Committee on Determinative Bacteriology of the Society of American Bacteriologists.—xii + 442 pp., Baltimore, Williams & Wilkins Co., 1923.

This manual is intended to provide a more detailed key for the identification of species, based chiefly on the system of classification of the bacteria elaborated by a committee of the Society of American Bacteriologists in 1917 and 1920, than has hitherto been available.

The introductory chapter gives a somewhat detailed review of previous classifications, and indicates that the system proposed by the above-mentioned committee has been departed from chiefly by accepting certain features of Castellani and Chalmer's classification as published in their *Manual of Tropical Medicine*, 1919.

Excluding *Actinomyces*, the great majority of plant pathogenic bacteria are grouped in the two genera *Erwinia* and *Phytomonas*, both included in the tribe Erwiniae of the family Bacteriaceae. They are defined as plant pathogens; growth usually whitish, often slimy; indol generally not produced; acids usually formed in carbohydrate media, forming acid or acid and gas; motile or non-motile; Gram negative. *Erwinia* has peritrichous flagella; while in *Phytomonas* the rods may be motile or non-motile, and when motile the flagella are polar.

Under *Erwinia* are included *E. amylovora* (the cause of pear and apple blight); *E. melonis* (the cause of soft rot in muskmelon, citron, cucumber, potato, carrot, beet, and turnip); *E. atroseptica* (the cause of stem rot or blackleg of potato, and also affecting cucumbers and other vegetables); *E. solanisapra* (probably synonymous with the last and known to attack tomato, *Capsicum*, &c., in addition to potato); *E. carotovora* (the cause of soft rot in carrots and other plants); *E. oleracea* (believed by some to be identical with the last, and causing soft rot of cauliflower, cabbage, and turnip); *E. aroidea* (the cause of soft rot in calla); *E. cypripedia* (isolated

from leaf disease of tropical orchids); *E. nicotiana* (isolated from wilted tobacco); *E. mangifera* (causing a mango disease); and *E. tracheiphila* (the cause of wilt of cucumber, cantaloup, musk-melon, pumpkin, and squash).

Phytomonas includes *P. campestre* (associated with black rot of cruciferous plants); *P. hyacinthi* (associated with yellow slime disease of *Hyacinthus orientalis*); *P. phaseoli* (associated with disease in beans and blight in related plants); *P. malvaceara* (the cause of angular leaf spot of cotton); *P. flaccumfaciens* (the cause of wilt of navy beans); *P. pruni* (the cause of black spot and canker of plum, peach, &c.); *P. medicaginis* (associated with stem blight of lucerne); *P. vasculara* (the cause of Cobb's disease of sugar-cane); *P. xanthochlora* (the cause of potato rot in Germany); *P. coronafaciens* (associated with blade blight of oats); *P. citri* (the cause of citrus canker); *P. pisi* (causes stem blight of field and garden peas; also pathogenic for lucerne, sweet, crimson and mammoth clovers, and cowpeas); *P. marginale* (causes a disease of lettuce in Kansas); *P. betacola* (causes 'tuberculosis' of beets); *P. exitiosa* (the cause of bacterial spot of tomato, forming lesions on different parts of the plant and on the green fruit; also pathogenic on leaves and fruit of *Capsicum annuum* and on leaves of *Solanum tuberosum*); *P. vitians* (the cause of a disease of lettuce in South Carolina); *P. lacrymans* (the cause of angular leaf spot of cucumber); *P. apii* (the cause of bacterial leaf spot disease of celery); *P. aptata* (associated with a disease of sugar beet and nasturtium leaves); *P. atrofaciens* (the cause of glume-rot of wheat); *P. tabacae* (the cause of wildfire of tobacco); *P. amaranthi* (found in disease of amaranths); *P. solanaceara* (the cause of brown rot of Solanaceae); *P. citrarefaciens* (associated with citrus blast); *P. viridilivida* (isolated from diseased lettuce leaves); *P. vignae* (produces leaf spot on cowpea); *P. marginata* (forms a circular to elliptical, rusty-red to dark-brown or purplish spots on leaves of gladiolus); *P. cannae* (the cause of bud rot of *Canna indica*); *P. tumefaciens* (cause of crown gall of *Chrysanthemum fructescens* and other plants); *P. agropyri* (the cause of a disease of wheat grass [*Agropyron*]); *P. savastanoi* (the cause of tubercle formation on olive trees); *P. mori* (associated with blight of the mulberry); *P. michiganensis* (the cause of bacterial canker of tomato); *P. stewarti* (the cause of Stewart's disease (blight) of maize); and *P. rathayi* (the cause of Rathay's disease of *Dactylis glomerata*).

Clostridium baccarinii (*Bacillus baccarinii* Macchiati) is given as the cause of a grape vine disease; *Actinomyces scabies* and the other species of this genus described by Wollenweber [see this *Review*, i, p. 183] causing scab on potato and beet are all recognized, the former being given as the cause of the disease in the United States; *A. poolensis* is stated to be associated with a disease of sweet potato; and *Chondromyces lichenocolus* is parasitic on lichens.

Keys for the identification of the species are given and each is described in detail.

STEVENS (F. L.) & DOWELL (RUTH I.). **A Meliola disease of Cacao.**—*Phytopath.*, xiii, 5, pp. 247–250, 3 figs., 1923.

A leaf spot disease due to the fungus *Meliola guianensis* n. sp.

was discovered, in August, 1922, to be very prevalent in the cacao plantations of Coverden, British Guiana, although it could not be said to be causing much damage. Spots of dead leaf tissue, 3 to 10 mm. in diameter, were produced, the *Meliola* being overgrown in some instances by a new species of *Helminthosporium* (*H. guianensis*) and in others by a *Nectria* (apparently *N. portoricensis*). In the former case the *Meliola* colony turned black, while in the latter it became white and thickly strewn with pale pink perithecia.

Diagnoses of the two new species are given.

WATERHOUSE (W. L.). **Some aspects of the Wheat rust problem.**—*Agric. Gaz. New South Wales*, xxxiv, 6, pp. 381–387, 1923.

Yellow rust of wheat (*Puccinia glumarum*) is not known to occur in Australia. Brown or leaf rust (*P. triticina*) occurs in the spring and probably causes considerable damage where the water supply is insufficient. It is almost entirely restricted to the upper surfaces of the leaves. In view of the fact that a number of Australian varieties of wheat are resistant to leaf rust, and since no biological specialization of the fungus has been demonstrated under Australian conditions, it should be easily possible to breed immune types.

Stem rust (*Puccinia graminis*), which in 1916 caused a loss exceeding £2,000,000 in New South Wales, usually appears towards the end of the summer. It has recently been shown that, at any rate under certain conditions, the barberry can act as an agent of rust transmission in Australia as well as in America and Europe. Without, however, discussing the rôle of the barberry in the development of the disease, the author, after referring to Stakman's work on the biological specialization of *P. graminis* [see this *Review*, ii, p. 158], points out the necessity of determining the biologic forms of the rust found in Australia and their distribution. When this has been done it will be possible to find a wheat suitable as regards rust resistance for breeding purposes, and investigations on these lines have already been instituted at the Sydney University.

MEHTA (K. C.). **Observations and experiments on cereal rusts in the neighbourhood of Cambridge, with special reference to their annual recurrence.**—*Trans. Brit. Mycol. Soc.*, viii, 3, pp. 142–176, 1923.

The results of investigations conducted at and near Cambridge from 1920 to 1922 showed that fresh uredosori of black rust (*Puccinia graminis*) are not found in that area after the beginning of winter, uredospores in old pustules exposed to the cold also soon losing their viability. It was further shown by observations and experiments that *P. graminis* cannot overwinter in the locality in question, even as mycelium within the plants. Direct infection of wheat by sporidia is not known, and there is no evidence to show that the rust can originate from 'mycoplasm', as suggested by Eriksson or from intra-seminal sori. The annual outbreak of the rust can, therefore, only be explained by fresh infection through aecidiospores produced on barberry.

Fresh uredosori of the brown rust of wheat (*P. triticina*) and the dwarf rust of barley (*P. simplex*) are found during the greater part of the winter. Uredospores taken from the open during winter invariably showed good germination. Fresh uredosori of the yellow rust of wheat (*P. glumarum*) were found during most of the winter of 1920–21, the uredospores from the pustules germinating well.

The most important factor in the annual recurrence of cereal rusts is the occurrence of plenty of uredospores on self-sown plants and tillers at the time when the autumn-sown crop appears above ground. The infection of young seedlings is followed by a somewhat lengthy incubation period, the exact duration of which varies with the species of rust and also depends upon climatic conditions—chiefly temperature. *P. graminis* flourishes better at high temperatures (average 66·5° F.), cold having a pronounced inhibitory effect on its growth; *P. triticina* occupies an intermediate position, and *P. glumarum* thrives at low temperatures (average 54·1° F.). At unfavourable temperatures the incubation period was prolonged from the normal eight or ten days to five or six weeks. A possible explanation for the sequence in the appearance of two of the rusts (first *P. glumarum* and then *P. triticina*, at Cambridge) is suggested by these data. The occurrence of *P. graminis* later than the other two is correlated with infection by aecidiospores from the barberry on which the aecidial stage does not appear till late in the spring.

Under artificial conditions the writer found that *P. graminis* germinated better at 29° to 30° than at 2° to 3° C., while with *P. triticina* and *P. glumarum* the situation was reversed; the latter, indeed, showed only 5 per cent. of germination at 22° to 23° C. and none at 29° to 30° C. Above 5° and under 20° C. all these rusts germinated well. The uredospores of *P. graminis* were found to keep better at ordinary temperatures for several weeks than those of either of the other two rusts, *P. glumarum* suffering the greater loss of viability.

It is claimed that the observations and experiments recorded in this paper preclude all possibility of an hereditary source of infection and offer an adequate explanation of the annual recurrence of the rusts.

Inoculation experiments with pure cultures of certain biologic forms showed that *P. graminis* from wheat infected only wheat and barley, rye and oats being immune, while the form from couch grass (*Agropyron repens*) readily infected couch grass, rye, and barley, and, contrary to the accepted opinion, was also found to infect one variety (Red Sudan) of wheat. *P. graminis* from barley infected barley, rye, and couch grass but not wheat. This form differs from that on wheat and is probably identical with that on couch grass. It would appear that as regards this species of rust, specialization in the Cambridge area is not quite so rigid as elsewhere, infected couch grass being a source of danger to barley.

P. dispersa f. sp. *secalis* from rye was found to be strictly confined to this host.

P. triticina from wheat infected rye somewhat feebly.

P. simplex from barley and *P. glumarum* from wheat were not found to infect other cereals.

GRINTESCU (J.). **Le noir des blés en Roumanie.** [The blackening of Wheat in Roumania.]—*Bul. Soc. Stiinte Cluj*, i, 3, pp. 292–295, 1923.

In 1920 the author examined a number of wheat plants grown near Bucharest which were attacked by a disease previously unknown in Roumania.

The leaves of the affected plants were withered and covered with elongated yellow spots encircled by an irregular, dark brown zone. When badly attacked the ears were stunted and frequently sterile, and the grain undeveloped and incapable of germination. The ears and especially the glumes were covered with small, brown spots. The plants were stunted and their blackish appearance singled them out from the rest of the stand.

Fragments of the diseased material were placed in a moist chamber at a temperature of 25° to 26° C., for 24 to 48 hours, when they were found to be covered with a luxuriant, olive-brown mould growth, in which three fungi, *Cladosporium graminis* [? *C. graminum* Cda], *Alternaria tenuis*, and *Fusarium avenaceum* were distinguishable. Material left for a longer period under the above conditions became covered with sterile hyphae of the two first-named organisms, with here and there the spore-cushions of *F. avenaceum*.

Inoculation experiments gave negative results in the case of all three fungi. Nevertheless, the disease is believed to be due to *F. avenaceum*, the other two being regarded as saprophytes.

STAKMAN (E. C.), LEVINE (M. N.), & BAILEY (D. L.). **Biologic forms of Puccinia graminis on varieties of Avena spp.**—*Journ. Agric. Res.*, xxiv, 12, pp. 1013–1018, 4 pl., 1923.

Experiments started by the authors in 1918 have resulted in the discovery up to the present of four definite and apparently constant biologic forms of *Puccinia graminis avenae* which differ in their reaction on three different varieties of oats, namely, Victory (both C. I. No. 1145 and Minn. 514), White Tartar (White Russian), and Monarch Selection. There is a possibility of the existence of a fifth form, which is being investigated by inoculation experiments now in progress and which may be merely a mechanical mixture of forms I and II. The geographical distribution of these biologic forms is not yet known definitely. The sources of 23 collections made in 1921 and 1922 are given in a table. Form I has been collected from Saskatchewan to Mexico and probably is widely distributed in the central part of the North American continent. Form II seems to be even more widely distributed in the same area and has been found also in Maine and in South Africa. Form III, a strain sent by G. F. Puttick from Potchefstroom, Union of South Africa, and Form IV, collected by Stakman at Upsala, Sweden, where it is extremely virulent, have not yet been found in North America.

Garber (R. T.). **Inheritance and yield with particular reference to rust resistance and panicle type in Oats.**—*Minnesota Agric. Exper. Stat. Tech. Bull.*, 7, 40 pp., 6 pl., 1922. [Rec'd 1923.]

The author describes in this paper his experiments carried out during 1918–1921 on the inheritance of rust resistance in oats and also his work on the correlation between rust reaction and yield and between panicle type and yield. Two open-panicled pure lines of oats, Minota and Victory, which are susceptible to stem rust (*Puccinia graminis avenae*), were crossed with a relatively resistant side-panicled pure line of White Russian.

The relative length and breadth of the stomatal passage through the guard cells on the under surface of the leaves of nearly matured plants of the Victory and White Russian oat strains used in the investigation indicate that the rust resistance of the latter is not caused by the relative size of the stomata, as Miss Allen found to be the case with wheat [see this *Review*, ii, p. 401]. The stomatal openings of the susceptible Victory average $5{\cdot}6\,\mu$ in width as compared with $7{\cdot}9\,\mu$ in the resistant White Russian. In the present case the cause of resistance appears to be physiological rather than morphological in character. Rust-infected susceptible plants gave rise to large, oblong uredosori producing relatively long lesions in the stem, while resistant plants under the same conditions were covered with minute uredosori not exceeding the size of a pin's head at the largest.

Rust resistance was found to be inherited as a dominant character depending on single factor difference for its expression. In both crosses, Minota × White Russian and Victory × White Russian, 3,044 F_2 plants and 377 F_3 families were examined for their reaction to rust. In all, the F_2 generations consisted of 2,340 resistant and 704 susceptible plants. Of the F_3 families, 106 bred true for resistance, 175 segregated in the ratio of three resistant to one susceptible plant, and 96 bred true for susceptibility. The segregating F_3 families produced 5,964 resistant and 1,970 susceptible plants.

In the above crosses, panicle type is dependent on a single main factor for its expression. The F_1 plants were open-panicled, though less so than their open-panicled parents. In all the F_3 families of both crosses there were 98 homozygous open-panicled, 213 showing segregation, and 66 homozygous side-panicled. In view of these data it seems that the two characters, rust reaction and panicle type, are not closely linked in inheritance. The factor difference controlling reaction to stem rust and the main factor difference controlling panicle type are either located in different chromosome pairs, or, if in the same chromosome pair, the factors cross over frequently.

The Victory parent produced on the average 12·4 per cent. aborted pollen, the corresponding figures for Minota and White Russian being 1·0 and 0·9 per cent. respectively. In the Victory-White Russian cross of 250 F_2 plants, seven produced percentages of aborted pollen within the range exhibited by the Victory parent. No evidence of a close association in inheritance between panicle type and pollen abortion was found.

In 1921 the F_2 and F_3 generations were analysed to determine the potency of rust in reducing yield of seed. In the F_2 generations the approximate average reduction of yield on account of rust in the Minota-White Russian cross was 12 per cent. among the open-panicled and 34 per cent. among the side-panicled types; in the Victory-White Russian cross 37 per cent. among the open-panicled and 24 per cent. among the side-panicled plants. In the F_3 generations the average percentage reductions of yield were 24, 14, and 37, 30 in the two crosses, respectively. The correlation between panicle type and yield was not consistent. In every case, however, where a significant difference was found, the open-panicled forms gave the greater average yields. Considering first the plants harvested individually, the resistant open-panicled plants of the Victory-White Russian cross yielded 16 per cent. more than the resistant side-panicled plants. Among the susceptible plants of the same cross, the side-panicled type yielded 15 per cent. more than the open-panicled. In the Minota-White Russian cross the average yield of the open-panicled resistant forms exceeded that of the side-panicled resistant forms by 14 per cent., whereas among the susceptible plants, forms with open panicles yielded on the average 25 per cent. more than forms with side panicles. Taking the yields in bulk, the open-panicled type in the Minota-White Russian cross gave the greater average yield (12 per cent.) among the resistant plants and the side-panicled type a slightly greater average yield (about 1 per cent.) among the susceptible plants. In the Victory-White Russian cross the open-panicled resistant plants yielded 7 per cent. and the side-panicled susceptible plants 4 per cent. more than the plants of the same rust reaction but of different panicle type.

A bibliography of about fifty titles, and numerous tables, are appended.

ARRHENIUS (O.). **Försök till bekämpande av Havrens gråfläcksjuka.** [Experiments in the control of grey speck disease of Oats.]—*Medd. Centralanst. försöksväsendet på jordbruksområdet*, 244, 17 pp., 1 col. pl., 1923.

The results of a series of experiments carried out in 1922 in connexion with a severe outbreak of grey speck disease of oats [see this *Review*, i, p. 417, and ii, p. 403] showed that the disease was due to a disproportionate quantity of lime in the soil as compared with other elements. The disease has not been known to occur in soils with a reaction below P_H 6, but otherwise the degree of acidity or alkalinity does not appear to be a decisive factor.

It was observed that the application of sodium nitrate, gypsum, calcium chloride, and calcium nitrate promoted the disease, while manganese, sodium chloride, and sodium sulphate controlled it.

The disease was most prevalent on light sandy soils with a plentiful admixture of humus, especially after applications of lime or marl. Excessive shade, which reduced the assimilation of carbon dioxide by the plants, was also injurious.

Osterhout has demonstrated the antagonism between calcium and sodium, and the same holds for ammonium and manganese. In grey speck disease the correct balance of the soil elements has

been disturbed by the excess of lime, which results in an undue assimilation of certain salts. These ill effects, as Hedlund has shown (*Årsskr. Lantbr. Mej. Inst.*, p. 41, 1921–22), are aggravated by the application of nitrates and counteracted by that of ammonium salts. Taken in conjunction with Hiltner's hypothesis that the disease is due to an excessive assimilation of salts in comparison with that of carbon dioxide, the antagonism hypothesis is of considerable importance. The application of sodium or ammonium salts not only counteracts the injurious effects of the lime but also seconds the fertilizing action of the latter.

In 1908 Nilsson-Ehle examined the susceptibility of different varieties of oats to grey speck disease. The following were found to be resistant: 01004 Hybrid Roslags; 04196 black kernel, stiff panicles; 03826 pedigree from Svalöv's beardless Probsteier; 0302 Svalöv's white Probsteier; Danish grey oats from Jutland; Mesdag; ordinary Roslags. The susceptible varieties were: 0924 ala; 0101 yellow kernel, plumed; Storm King; Tartar King; 0495 black kernel, stiff panicles; 0660 North Finnish pedigree; 01051 black Tartar plumed, limp panicles.

Since that date the Svalöv Experiment Station has tested a number of other varieties, of which the following are resistant: Strube's Schlanstedter; Perle; Melog I; Grey kernel Fyris; 08/20 Norbotten 0670 from German moor oats; yellow Näsgärds. The following are susceptible: Thor; v. Lochow's yellow; Odin; Plumed; 0353 Ligowo II; 0386 Guldregn; 0450 Grand Mogul; 01220 c Björn II, 01162 from Orion. In the 1922 experiments Mesdag was slightly attacked, Odal, Klock II and III, Orion, Eko, Fortuna, Grand Mogul, and Björn being severely infected.

VOGT (E.). **Ein Beitrag zur Kenntnis von Helminthosporium gramineum Rbh.** [A contribution to the knowledge of *Helminthosporium gramineum* Rbh.]—*Arb. Biol. Reichsanst. für Land- und Forstwirtsch.*, xi, 5, pp. 387–397, 4 figs., 1923.

In this paper the author gives an account of his work on the transmission of stripe disease (*Helminthosporium gramineum*) of barley, the investigation of which was undertaken in order to provide a scientific basis for the treatment of the disease.

Helminthosporium gramineum, the history and distribution of which are briefly described, first appears on the leaves of affected barley plants in the form of elongated clusters of conidia. The yellowish-brown, five- to eight-septate, coarse-walled conidia, up to 160 μ in length, are abstricted from conidiophores and are easily caught up by the wind. In the autumn, black, almost spherical sclerotia, 400 to 800 μ in diameter and covered with stiff, blackish setae, are found on the stubble of diseased plants. In the following spring these sclerotia develop into perithecia [*Pleospora graminea*] containing eight ascospores with muriform divisions.

The success of seed disinfection is based on the ability of the steep to destroy or weaken the parasite while not causing any injury to the host plant [see this *Review*, ii, pp. 551–560]. Since the action of the fungicide progresses comparatively slowly in the internal cell layers of the seed, the parasite, in a satisfactory method of disinfection, should have already succumbed at a stage

when the embryonic tissues of the host are not yet exposed to injury.

The successful control of the disease by chemical steeps (e.g. germisan and uspulun) [see this *Review*, ii, p. 161] indicates that the fungus either adheres externally to the grain or is contained in the glumes or outer cell layers of the seed, the embryo remaining free from infection. The ascospores are not formed till the spring of the following year or the one after that, and although they may, under suitable conditions, produce a local infection on the leaves of young barley plants, they appear to be of no practical importance in the transmission of the disease, especially as the development of the perithecia is held in check by the ordinary routine of field practice. The responsibility for the spread of the disease during the summer may, therefore, be said to rest almost entirely with the conidia.

H. gramineum (unlike *H. teres*, the causal agent of leaf spot of barley) is not very readily able to infect healthy plants in the above ground parts. Ravn (*Zeitschr. für Pflanzenkrankh.*, xi, p. 13, 1901) obtained positive results in artificial inoculation experiments with *H. gramineum* only in 29 per cent. of the cases as compared with 95 per cent. with *H. teres*. These results were confirmed by Noack's and the author's own tests, the latter being carried out in 1921–22.

The material used in the experiments consisted of a winter barley from Central Germany and a summer barley from Westphalia, both harvested in 1921 and rejected for sowing purposes on account of the heavy incidence of stripe disease. Healthy material was used for comparison. Lactic blue proved very satisfactory for staining the characteristic thick-walled mycelium which was found in nearly all the seeds between the glumes and the pericarp. The hyphae of the resting mycelium, grouped in irregular strands of varying dimensions, traverse mainly those parenchymatous cell layers which arise through the fusion of the inner glume epidermis with the outer cell layer of the pericarp. The cells of the hyphae are cylindrical, often barrel-shaped, thick-walled, yellow to yellowish-brown in colour, and extremely variable in size. Those in the middle of the hyphae have an average diameter of 8 to 9 μ and a length of 12 to 15 μ, while towards the ends of the hyphae the diameter of the cells often decreases to 3 to 5 μ. Often the hyphal strands are so closely woven as to resemble mycelial clumps. The presence of the mycelium was not detected in the interior of the endosperm, scutellum, or embryo.

Cultures of the mycelium from the pericarp on 2 per cent. malt extract agar proved to be identical in all respects with pure cultures of the mycelium obtained from the conidia of *H. gramineum*. Neither conidia nor perithecia developed from the cultures, though the typical sclerotia referred to above were readily obtained on sterilized haulms of barley.

The identity of the fungus, however, was established almost beyond a doubt by certain peculiarities in the growth of the mycelium on solid nutrient media. The hyphae on the surface of the medium describe arc-shaped curves, always to the left, so that their collective appearance may be compared to a paddle-wheel. On the other

hand, the comparatively inconspicuous hyphae below the surface of the medium develop radially. This strikingly uncommon type of development was observed in over one hundred cultures of *H. gramineum*, whereas in the cultures of *Botrytis*, *Moniliopsis*, and *Penicillium* spp. examined for purposes of comparison, such a form occurred only in occasional cases. The spiral type of development may, therefore, be regarded as a distinguishing characteristic of *H. gramineum*.

Another striking characteristic of the cultures was the method of cell reproduction, which was effected by division of the terminal hyphal cells by means of the formation of a number of cross walls, three to five at a time, at intervals of 70 to 80 minutes in cultures on malt extract at room temperature.

Microscopical examination has shown that the mycelium in the pericarp is primarily, if not exclusively, responsible for the transmission of the disease. Immediately after the seed is sown the access of humidity stimulates the growth of this mycelium, hyphae from which penetrate the young seedling. The sprouting hyphae are smaller in diameter than the cells of the resting mycelium, thin-walled, and much branched. They are deficient in protoplasm and not readily stainable. The actual process of the penetration of the hyphae into the plant tissues was observed.

The mode of infection of *H. gramineum* is stated to resemble that of *Ustilago avenae* as described by Zade [see this *Review*, ii, p. 214], the causal organism in both cases being blown on to the blossoms, where it develops into a mycelium and becomes established in the seed coats of the ripening grain.

The fact that the transmission of the disease is effected by means of seedling infection is of great importance in its control by means of chemical disinfectants. The causal organism, situated in a relatively accessible position between the glumes and the pericarp, is easily reached by the fungicide, the interior of the seed remaining unharmed.

CHRISTENSEN (J. J.). **Studies on the parasitism of Helminthosporium sativum.**—*Minnesota Agric. Exper. Stat. Tech. Bull.*, 11, 39 pp., 10 pl., 2 diag., 1922. [Rec'd. 1923.]

Helminthosporium sativum Pammel, King, and Bakke, which is becoming increasingly widespread on wheat, rye, and barley in the United States, appears also to be distributed over extensive areas in Canada, Mexico, the Argentine, and Australia, inoculations with cultures from these regions producing the typical symptoms of the disease on wheat, emmer, barley, and rye. In Minnesota the disease is extremely prevalent, causing a stunted, spindling, or rosette appearance of the infected plants and a severe decay of the root system. In 1922 the damage to barley and wheat in several counties of Minnesota was estimated at 10 to 20 per cent.

The first noticeable symptom of the disease is a seedling blight resembling that due to damping-off; in some cases the attack on the roots may be so severe that the plants are unable to push out of the soil. Badly infected seeds may fail to germinate at all. A conspicuous characteristic of the disease is the stunting of infected plants, which generally occurs in circular or irregular patches

(occasionally also sporadically). The basal leaves of the stunted plants are often darker green than the normal, and large chocolate-coloured lesions appear at the base of the shortened and sometimes curling first leaves. Severely infected plants often stool excessively, as many as thirty or forty culms not being uncommon, especially on diseased barley; frequently, however, only a few of these develop normally and produce seeds. Another common symptom of the disease in Minnesota, especially on wheat, is the complete prevention of stooling, the new shoots being attacked on emergence from the sheath. Other symptoms are brittleness and decay of the roots, poorly filled heads, and sometimes shrivelling of the seeds.

All the above symptoms are due to seed or soil infection. Subsequent secondary infection which may result from spores produced on the primary lesions, from old infected plants, or from diseased common grasses, usually appear as dark brown, oval or irregular blotches which vary, however, to some extent with the host. For instance, on einkorn and *Bromus villosus* the lesions have a light centre bordered by a halo, and on certain varieties of rye a water soaked leaf spot, with or without a brownish border, is produced. On *Andropogon sorghum* the lesions are red and oval and on *Agropyron repens* they are elongated and black. The lesions vary greatly in size on the same leaf, which may also show different types of infection. The stems, glumes, awns, and seeds may be similarly affected. The pathogen fruits abundantly on the nodes, imparting to them a black, velvety appearance, and, under favourable conditions, it also fruits on the shrunken kernels. The ovary of the floret is liable to attack at any stage of its development, and sometimes the rachis may also be infected. In nature the organism fruits abundantly on the glumes of the spikelets of wheat, emmer, spelt, and einkorn.

In addition to the crops already mentioned, 32 species of common grasses were shown to be susceptible to the disease. Those most frequently attacked are *Setaria viridis*, *Hystrix patula*, *Chloris verticillata*, and various species of *Agropyron*, *Bromus*, *Elymus*, *Festuca*, *Hordeum*, and *Lolium*. Immune or extremely resistant are *Phleum pratense*, *Arrhenatherum elatius*, *Alopecurus pratensis*, *Koeleria cristata*, and species of *Phalaris*, *Poa*, and *Agrostis*.

Field and greenhouse inoculation experiments with Form 1 of the four biologic strains of the fungus distinguished in the course of the investigations proved that Marquis, Monad, and Red Durum wheats were extremely susceptible to root infection, while Kanred was resistant. Of the barleys, Lion, Bay Brewing, and Arequipa were very susceptible, while Manchuria and Minnesota No. 184 were resistant. Oats were highly resistant and rye only slightly susceptible. The typical symptoms of the disease were produced by artificial inoculation in the susceptible plants.

The four biologic forms of *H. sativum* differ physiologically, as indicated by the rate and character of their growth on the same and different media and the variability of the degree of infection produced on the same hosts. The spores of the forms differ slightly in shape, width, and length, and in the number of septa. The extreme variation of an individual biologic form of *H. sativum* under different conditions, and of different forms under the same

conditions, makes it almost impossible to give a technical description of the species which would be universally applicable.

H. sativum overwinters as mycelium in the seed and on plant refuse in the field, viability having been proved to extend over a period of several years. Under laboratory conditions the spores also remain viable for a considerable time (up to 23 months), but apparently they cannot withstand the humidity of an outdoor winter.

The control of the disease is extremely difficult, but the use of clean seed, rotation of crops, and the cultivation of resistant varieties will reduce its prevalence. Early sowing is recommended, as the organism flourishes at high temperatures and the cereal seedlings develop better when the soil is comparatively cool (40° to 60° F.).

MITRA (M.). **Helminthosporium spp. on cereals and Sugarcane in India. Part I. (Diseases of Zea mays and Sorghum vulgare caused by species of Helminthosporium.)**—*Mem. Dept. Agric. India*, Bot. Ser., xi, 10, pp. 219–242, 3 pl., 1923.

The author undertook the study of the species of *Helminthosporium* occurring on cereals and sugar-cane in India in order to determine the range of their host plants, and to ascertain whether morphologically similar forms from different hosts vary in range of host, or morphologically dissimilar forms have the same host range. The present paper deals with the species parasitic on maize (*Zea mays*) and on jowar (*Sorghum vulgare*).

The species on jowar has been observed only in the Punjab where it does slight damage to the crop. Morphologically it is identical with that on maize—*H. turcicum*—but since both strains behave somewhat differently in pure culture and that on maize has only been observed in Bihar while that on jowar is recorded only from the Punjab, the author believes that they are different biologic forms. Descriptions are given of the symptoms of the diseases on both hosts, of experiments which establish the pathogenicity of each strain (the form on maize occurring on both the leaves and the male inflorescence), of the morphology of the parasites, and of their growth in culture on various media. A perfect stage has never been observed. The form on maize preferred a medium with a reaction of 0° to + 10° (and especially of + 5°) Fuller's scale. Spores of this strain also gave 90 per cent. germination when kept for four months and 50 per cent. when kept eight months, after which they rapidly lost their power of germination, none occurring after a year. The penetration of the fungus on maize was studied and found to take place either through stomata or by directly penetrating into an epidermal cell.

Cross-inoculation experiments showed that both strains can infect maize, jowar, wheat, barley, oats, and sugar-cane, while the results on bajra [*Pennisetum typhoideum*] were negative, and on rice doubtful.

GAINES (E. F.) & STEVENSON (F. J.). **Occurrence of bunt in Rye.**—*Phytopath.*, xiii, 5, pp. 210–215, 2 figs., 1923.

Previous investigators appear to have assumed that bunt or

stinking smut, caused by *Tilletia tritici*, is confined to wheat. In the autumn of 1921, however, one plant of common rye, one F_2 plant of a rye-wheat hybrid, and two F_2 plants of a wheat-rye hybrid, were found affected with a smut, the fetid odour, size, shape, and roughened surface of the spores of which appeared to leave no doubt as to its identity with *T. tritici*.

To test further whether rye is a host of this fungus and to determine how far bunt infection of rye could be induced by artificial means, nine winter ryes and the F_2 generation of each of four wheat and rye hybrids were heavily inoculated with spores of *T. tritici* from wheat and sown under conditions favouring maximum infection on 8th October 1921. Fourteen spring varieties of rye were also treated in the same way and sown on 29th April 1922. The results of the 1922 harvest showed that four of the nine winter ryes were very slightly susceptible to bunt, while the other five were apparently immune. The wheat and rye hybrids were all susceptible in very varying degrees. The spring ryes were all free from disease, except for very slight infection in the Beardless, Yellow, and Rosen plots, presumably due, in the two latter cases, to soil infestation. It seems probable that the two bunted plants in the Rosen plot were not pure Rosen but hybrids with other ryes, as the nursery rows of pure Rosen could not be induced to yield any bunted heads at all.

The question arose whether a new specialized form of bunt capable of attacking rye had appeared, and its behaviour to wheat therefore required testing. Three susceptible wheat varieties, Baart, Jenkin, and Pacific Bluestem, were sown in three plots, one infected with spores from the bunted rye head of the previous season, the second with spores from a bunted rye-like plant of the F_2 generation of Rosen rye × Hybrid 128 wheat, and the third with spores from a wheat-like plant found in the F_2 generation of Turkey wheat × Rosen rye. In every case the number of bunted heads produced was less than would have been expected if the seed had been inoculated with spores from the normal host. No bunt appeared on three spring varieties of rye inoculated with spores from the same hosts. Thus it appears that *T. tritici* may pass one generation on rye as a host and still attack wheat feebly, but it does not seem able to produce a second generation on rye.

It seems possible from the description of *T. secalis* that *T. tritici* and *T. secalis* are in reality the same fungus on different hosts, the rarity of the latter according well with the great resistance of the rye varieties to *T. tritici* shown in the above experiments.

The susceptibility to bunt of the rye-wheat hybrids will be useful as an index of genetic relationships in these hybrids. After the first generation they have all resembled the female parent to such a degree as to be mistaken for pure line ryes. The fact that the third generation families of Rosen × Hybrid 128 were susceptible to bunt as compared with the Rosen parent, indicates, however, that they were true hybrids.

HEALD (F. D.) & BOYLE (L. W.). **Further notes on the relation of the spore load to the per cent. of stinking smut appearing in the crop.**—*Phytopath.*, xiii, 7, pp. 334–337, 1923.

Further tests of the relation between the quantity of bunt spores

on the grain and the amount of bunt in the succeeding crop [see this *Review*, i, p. 169] are recorded. One-hundred-gramme lots of grain of each of four varieties of wheat were contaminated by shaking in a glass bottle with different quantities of bunt spores from 0·04 to 3 gm. Others were treated with a spore suspension in water containing 0·02 gm. or less of bunt spores per 100 gm. grain, by means of an atomizer.

The smut was distinctly evident by the coloration of the 'brush' in all samples down to and including 0·08 gm. of powdered smut to each 100 gm. of seed, and on the white grains down to 0·04 gm. Grain may carry several thousand smut spores per seed and still show no evidence of smut to the naked eye.

The maximum infection was obtained with one gm. of smut per 100 gm. of seed with Early Baart, Jenkin's Club, and Little Club (70, 72, and 38 per cent. bunted, respectively), while in the case of Marquis, Hybrid 143, and Bluestem two gm. of smut were required to produce the maximum effect (17·4, 78, and 53 per cent. respectively). The tests are of value as indicating the amount of smut which might be expected if visibly clean seed is selected for planting, spore loads below 0·08 gm. giving 0·0 to 6·9 per cent. infection. It was previously shown that the percentage of infection is less under field than under experimental conditions, and it seems probable that even susceptible varieties may be seeded in the spring without disinfection, as long as they appear clean to the naked eye. Further tests with naturally infected grain showed that visibly clean seed gave from 0 to 1 per cent. bunted with spore loads up to 966 spores per grain.

MANNS (T. F.) & ADAMS (J. F.). **Parasitic fungi internal of seed Corn.**—*Journ. Agric. Res.*, xxiii, 7, pp. 495–523, 13 pl., 1923.

Besides the four fungi mentioned in the preliminary report of the authors' work, namely, *Cephalosporium sacchari*, *Fusarium moniliforme* (believed to be identical with *Oospora verticilloides*), *Gibberella saubinetii*, and *Diplodia zeae* [see this *Review*, i, p. 55], species of the following genera were also found in the interior of maize grains: *Aspergillus*, *Cladosporium*, *Penicillium*, *Alternaria*, *Helminthosporium*, *Rhizopus*, *Spicaria*, *Hormodendrum*, *Torula*, *Chaetomium*, and *Colletotrichum*, besides several bacteria. All these, however, except the first four, appear to be of secondary importance and probably become established only as the result of unfavourable field and storage conditions.

Cephalosporium sacchari, which is fully described and figured, is much the most prevalent parasitic form in Delaware. A footnote added while the paper was in the press indicates that there is some doubt as to its determination, cultures under this name from India proving to be a *Fusarium*.

The manner in which infection is carried in the seed and the process of infection of the embryo was studied by cultural and histological methods. The four parasitic forms become established in the tissue of the cap and the cavity between the cap and the dorsal point of the scutellum. In some cases the fungus works upward beneath the pericarp, and under certain favourable conditions not yet determined the embryo is infected and destroyed.

This method of infection precludes the possibility of successful seed disinfection.

There are two ways in which infection of the seed might take place: (*a*) direct kernel and blossom infection and (*b*) indirect seed infection by means of systemic stalk or shank infection. The study of infected kernels, however, failed to give proof of the former and whilst there is no reason to doubt that a systemic infection occurs, its frequence was not determined. Such infection may originate from infected seed, from infected soil, or the stalk or shank may be the initial point of attack. No conclusive evidence was obtained as regards the exact manner in which the infection becomes established in the seed.

The symptoms of infection produced by these organisms are not consistent. Various discolorations of the germ end of the kernel are found, and these are always associated with infected seed. In some cases, however, infected kernels and ears may appear externally normal and severe internal infection of plants even in the tassel stage has not caused any pronounced external symptoms.

Morphological and cultural details of the four parasitic forms are given, together with extensive tables of their distribution in Delaware and other states. Their frequency in Delaware is in the order given above, but the inhibition of germination caused by them is in the reverse order.

HOFFER (G. N.) & CARR (R. H.). **Accumulation of aluminium and iron compounds in Corn plants and its probable relation to root rots.**—*Journ. Agric. Res.*, xxiii, 10, pp. 801–821, 21 pl. (1 col.), 1923.

Severe root rotting of maize plants is frequently accompanied by a brown to brownish-purple discoloration of the vascular plate tissues of the nodes, which has been observed in plants at all stages of development. In a large majority of cases the fungi *Fusarium moniliforme*, *Gibberella saubinetii*, *Penicillium* sp., and *Rhizopus* sp., and a white bacterium may be isolated from the affected tissues, especially in the lower parts of the stalk, but the presence of these organisms is by no means invariable. In any case they would appear to be of secondary importance in the disintegration of the nodal tissues, which begins prior to their invasion.

Field observations and experiments show that the greatest number of seedling injuries occur in soils where these nodal troubles are most abundant. Microchemical tests conducted on the discoloured tissues proved the presence in them of organic compounds of iron and aluminium.

The most severe outbreaks of root rot occur in soils which are deficient in lime and available phosphates and which have varying quantities of aluminium and iron available for absorption. It is believed that the resistance of maize plants to root rots may be closely related to a selective absorptive capacity of such plants against aluminium and iron when these metals are available in subtoxic concentrations, a condition usually associated with acid soils. The quantity of available aluminium compounds in certain soils, however, may be sufficient to overcome the natural resistance of strains which show good growth in soils with lower concentra-

tions of available iron and aluminium salts. Analyses of the leaves from diseased and healthy stalks show wide variations in the quantities of aluminium in them. The average aluminium (Al_2O_3) content of the ash of normal leaves from an Indiana field in 1920 was 0·44 per cent., that of the diseased leaves being 0·98 per cent. The calcium (CaO) content was 0·70 per cent. in the normal, and 0·56 per cent. in the diseased leaves.

The typical discoloration mentioned above and definite chlorophyll and leaf tissue changes have been artificially produced by injecting into the plants solutions of certain salts of aluminium and iron through straight calcium chloride tubes inserted in the stems. These artificial changes closely resemble the phenomena which develop in plants growing in the field under conditions favourable to root rots. A definite cumulative toxicity of aluminium salts within the plants was established by the injection experiments, and it is believed that the same phenomenon occurs naturally in the field. The relative quantities of the available metals and nitrates in the soil largely determine the rate of development of the cumulative toxicity of the metals within the plants. The plants containing the largest quantities of these metals are those which seem to develop the most severe cases of root rot when the organisms mentioned above are present in the soil and meteorological conditions favour their growth.

The occurrence of numerous aluminium injuries in maize plants in certain fields is an indication that the soil is deficient in available phosphates. The application of lime and phosphates to soils in which root rots have developed in destructive proportions have been decidedly beneficial in the control of these diseases. When lime is added to acid soils, aluminium and iron compounds available are thought to be destroyed, but if some still remain the addition of soluble phosphates rapidly precipitates them. In some cases the use of limestone alone proved injurious, but vigorous and resistant plants were produced in all the experiments with available phosphates.

Hoffer (G. N.) & Trost (J. F.). **The accumulation of iron and aluminium compounds in Corn plants and its probable relation to root rots. II.**—*Journ. Amer. Soc. Agron.*, xv, 8, pp. 323–330, 1923.

In continuation of the work already reported on the connexion between iron and aluminium compounds and root rots of maize [see preceding abstract], a series of experiments was conducted to determine if there is any relation between the physiological effects of such compounds on the plants and the susceptibility of the latter to the fungous parasites involved.

In the first experiment five samples of soil from Indiana fields severely attacked by root rots, and a sixth sample of virgin soil from the Purdue Agricultural Experiment Station, were given similar treatments of lime (3 tons per acre), acid phosphate (500 lb. per acre), lime and acid phosphate, and aluminium chloride (500 lb. per acre) respectively. Similar portions were left untreated for control purposes. The treated and untreated soils were placed in Wagner pots and arranged in duplicate sets, six kernels of Yellow

Dent maize being planted in each pot. Uniform conditions of temperature and humidity were maintained. After ten weeks the results showed that in every case the percentages of aluminium oxide were lower in the plants grown in the soils treated with either lime (average 0·26) or phosphate (0·23) or both (0·24) than in those grown in soils treated with aluminium chloride (0·46). The percentages of iron oxide were less uniform, but in two cases the percentages were lower in the plants grown in the soils treated with lime (0·059) or phosphate (0·052) or both (0·050) than in those grown in the corresponding untreated soils (0·086). In three cases much higher percentages of iron oxide were found in the plants grown where aluminium chloride had been added (average 0·165) than in those grown in untreated soils (0·044). The roots of the plants in all the soils treated with aluminium chloride were severely attacked by *Fusarium moniliforme*, while some degree of injury by the same organism was observed in the plants on all the other treated and untreated soils. With one exception, the best growth of plants occurred in the soils treated with acid phosphate alone, the lime treatment being beneficial in two cases only.

A second experiment was conducted to ascertain whether strains of maize possess different capacities to absorb aluminium compounds when grown under similar conditions; and, if so, whether a correlation exists between such absorption and susceptibility to root rot. Four sets of sand cultures were prepared, each set consisting of six pots. To each pot were added equal quantities of a solution containing monocalcium phosphate 0·302 M, calcium nitrate 0·0075 M, ammonium nitrate 0·005 M, potassium chloride 0·004 M, magnesium sulphate 0·004 M, and manganese sulphate 0·00001 M. To one set was also added 0·005 M normal aluminium sulphate; another set received aluminium sulphate and monocalcium phosphate; a third set aluminium sulphate and calcium carbonate; while the fourth had the basic nutrient solution only. Four seeds of Burr Leaming and Yellow Dent strain 129 were planted in each pot, those in three pots of each set of cultures being inoculated with *Gibberella saubinetii*. The inoculated and uninoculated pots were placed in soil temperature tanks at about 18° C. At the end of six weeks the uninoculated plants of the Yellow Dent strain 129 in the cultures treated with aluminium sulphate contained 0·70 per cent. of aluminium oxide in the dry matter, the Burr Leaming plants in the same pots averaging 0·40 per cent. Associated with the higher percentage of aluminium oxide in the former variety was a greater tendency of these plants to blight when inoculated. The same strain was relatively little affected by the fungus when grown in pots receiving acid phosphate and calcium carbonate in addition to the aluminium sulphate.

In 1921 some maize plants affected with root rot were sent from North Carolina, where they had been growing in a muck soil for several years. The disintegrated nodal tissues of the plants contained large quantities of iron compounds. A series of experiments was undertaken to ascertain if the nodal disturbances and the root rots could be controlled by the use of fertilizers and limestone, three plots being treated with phosphate, potash, and limestone respectively, and one left untreated. It was found that the

quantities of iron compounds varied considerably in the nodal tissues of plants from the different plots. The application of potash (480 lb. kainit) with four tons of lime reduced the iron oxide content of the nodes from 0·084 to 0·019 per cent. The plants in all the plots receiving potash either alone or in combination with other treatments showed only slight accumulations of iron, while the absorption of aluminium (which was relatively low in all the plants) and its distribution in the plants was unaffected by any treatment.

The chief interest of the experiments discussed above lay in the effects of the metals upon the tissues for the conduction of the sap and elaborated foods in the aerial parts of the plants. Potash is known to be important in the translocation of foods within plants, and it is possible that in the maintenance of normal functioning vascular bundles it is of considerable value to the maize plant.

The specific reactions occurring in the nodal tissues of maize are extremely complex and are, in some way at present undetermined, related to an increased susceptibility of the plants to root rots.

ADAM (D. B.). **Experiments in Citrus fruit storage.**—*Journ. Dept. Agric. Victoria*, xxi, 5, pp. 307–317, 2 figs., 1923.

Almost all the cool storage losses in citrus fruit are due to moulds of which the author isolated *Botrytis cinerea*, *Penicillium digitatum*, *Penicillium italicum*, *Sclerotinia libertiana*, *Alternaria citri*, *Pythiacystis citrophthora*, *Dematium pullulans*, and *Cladosporium* sp. from fruit in the experimental chambers used for his investigations [see below, p. 41]. Of these the first three are the commonest, *P. digitatum* being the worst.

As the result of experiments in the storage of Washington Navel oranges shipped from Australia to Great Britain, 34° F. is recommended as the standard temperature for oranges. Tests were made of the comparative efficiency of various kinds of wrappers, of which the common sulphite tissue paper was found to be the most satisfactory, keeping the fruit bright and free from disease.

'Sweating', the term applied to the removal of a portion of the moisture from the rind of oranges, generally done by spreading out on a shelf after picking, for from three days to a fortnight, resulted in a reduction in the incidence of mould, especially *B. cinerea*. The stalk end of the fruit is the most frequent seat of infection with this fungus, the result being the development of a condition known as 'black eye'. It was found that sweated oranges lost the small stalk or button which usually adheres to the fruit when gathered from the tree. None of these oranges developed 'black eye', which was very prevalent in less thoroughly sweated fruit. The maximum period required under ordinary conditions for the completion of the process is a fortnight, at the end of which the buttons are easily detachable by hand.

Certain experiments indicated that the relative humidity of the air in immediate contact with the oranges in a case is the chief factor in the development of *B. cinerea*, whereas the temperature of the fruit and surrounding air is the chief factor for the citrus-rotting species of *Penicillium*.

It was observed that Late Valencia oranges stored better than

the Washington Navels, presumably on account of some inherent quality in the rind of resistance to moulds. The Riverside consignment of Washington Navels, grown on grey Murray silt under dry weather conditions, fared better in transit than that from the red sandy hillside of Tresco, where there was a heavy rainfall during the period of growth.

A brown coloration of the rind, varying in extent and regularity, and known as 'spotting' or 'blotching', sometimes occurs in oranges in cool storage. It was observed in the course of the present investigations that more oranges were affected at 37° than at 32° F. Oranges just picked and stored (especially if moist) spotted more severely than those previously sweated. Blotching is referred to two causes: (*a*) an arrested *Botrytis* infection, resulting in the formation of small, dry, circular, depressed areas; or (*b*) the injurious action of oils liberated from the rind. One of the most serious cases in the writer's knowledge occurred in oranges stored at a low temperature in a direct expansion chamber, the relative humidity in which at 32° F. ranges from 90 to 100 per cent. The variations of air temperature under actual commercial conditions in such a chamber may be two or three degrees, and this causes the deposition of thin films of moisture on the fruit, which is probably correlated with the incidence of blotching.

Under the best set of conditions available the author thinks that oranges ought to be capable of keeping for three months in cool storage without undue loss.

BRITTLEBANK (C. C.). **Diseases of the Cotton plant.**—*Journ. Dept. Agric. Victoria*, xxi, 4, pp. 242–244, 1923.

Although neither cotton wilt (*Fusarium vasinfectum*) nor anthracnose (*Glomerella gossypii*) has been reported to occur in Australia, there is a possibility of their presence in Queensland, where cotton has been grown for fifty years. It is therefore recommended that Queensland and other foreign cotton seed imported into Victoria should be immersed for 10 to 15 minutes in commercial sulphuric acid, washed in a large quantity of running water for 20 minutes, allowed to drain, and finally placed in corrosive sublimate 1 in 1,000 for 15 minutes.

The results of experiments carried out at the Department of Agriculture have shown that germination is slightly increased and the development of the plants promoted by this treatment. A further comparison between treated and untreated seed resulted in the isolation from the latter of an undetermined species of *Fusarium*, which in some cases entirely inhibited germination. The inoculation of seeds with the spores of the fungus gave positive results.

It was also shown that immersion in sulphuric acid for periods up to four hours had no adverse effect on germination.

COTTERELL (G. S.). **The biological control of insect pests of crops.**—*Journ. Gold Coast Agric. & Comm. Soc.* ii, 2, pp. 103–109, 1923.

In this paper the author discusses the importance of entomogenous fungi as agents in the control of insect pests and states that

in the Gold Coast with its humid climate fungi are especially useful. A severe outbreak of coco-nut leaf scale, due to an *Aspidiotus*, was suppressed in 1913 by the red-headed fungus (*Sphaerostilbe coccophila*), while the Cola weevil and other insects are liable to attack by *Botrytis* (*Beauveria*) *bassiana*. The disadvantage of the latter is its slow rate of growth, which gives time for the weevil to accomplish oviposition.

THAYSEN (A. C.) & BUNKER (H. J.). **The destruction of cellulose fibres and fabrics by micro-organisms and the importance of the microscope in the study of this destruction.**—*Journ. Roy. Micr. Soc.*, 3, pp. 303–310, 2 pl., 1 fig., 1923.

There appear to be three types of deterioration of cellulose fibres, due respectively to physical, chemical, and microbiological agencies, the last-named only being discussed in the present paper.

During the world war statistics were collected which showed that, of all the raw cotton imported into Great Britain for military purposes, 10 to 15 per cent. was disintegrated into very short fibres, technically known as 'fly'. It was ascertained by careful examination that this destruction of the fibres coincided with an increase in the content of cellulose-disintegrating bacteria. The 'fly' condition was, moreover, artificially reproduced by the inoculation of damp, sterile samples of raw cotton with the appropriate bacteria. The minimum moisture requirement for the inception of deterioration in raw cotton was determined in a series of experiments to be about 10 per cent.—a somewhat low figure considering that cotton fibres normally contain from 6 to 8 per cent. of moisture.

It was found that cellulose-destroying bacteria were present on even the best and cleanest samples of raw cotton, and in order to trace the various stages of the breakdown the attacked fibres were examined microscopically. Even at very high magnifications, however, the differences between normal and diseased fibres were insufficient for purposes of comparative investigation, and the fibres were therefore subjected to a preliminary treatment with carbon bisulphide and sodium hydrate solution to induce swelling.

The 'cuticle' of the damaged fibres was found to have lost its resistance, the fibres in many cases being extensively cut. Denham (*Journ. Text. Inst.*, xiii, 1922) suggests that the destruction of cotton fibre attacked by micro-organisms generally proceeds from the centre outwards, but the present investigations indicate exactly the reverse to be the case.

The destruction of all the Indian cottons (27 per cent. in 18 days) proceeded much more rapidly than that of the American (12 per cent. in 39 days) and Egyptian (15 per cent. in 30 days) types, even when the latter were artificially infected with cellulose-destroying bacteria. All the samples were wetted before testing.

It is evident from these figures that the exposure of bales of raw cotton to periodic wettings from the time of the harvest till milling must result in serious damage (estimated at $70,000,000 per annum in America), especially to the susceptible Indian types. It is unlikely that any improvement in the present system of handling will be effected in India in the near future, but the introduction of the comparatively resistant American varieties for commercial

purposes may help to minimize the losses. The authors have examined several samples of American cotton which have been grown in India for over forty years and still maintain their original resistance to bacterial decomposition.

Preliminary studies of the importance of food substances for the bacteria responsible for the breakdown of the fibres indicate that an addition of food to slowly deteriorating cottons increases the rate of destruction, while others remain relatively unaffected. To the former class belong samples of American cotton grown in India, those obtained direct from the United States retaining a part, at any rate, of their resistance to rapid decomposition. These data suggest that, besides the absence of food, a more positive factor is responsible for resistance to breakdown, and it is this latter which is adversely affected by climatic conditions.

The rate of destruction of flax was also quantitatively determined, and it was found to be considerably more rapid in the tank-retted than in the dew-retted product (21 as against 7 per cent. of deterioration in 34 days). It was impossible to estimate quantitatively the deterioration of jute and hemp fibres owing to their arrangement in twisted bundles, but disintegration in the samples infected by micro-organisms proceeded on the same lines as in cotton and flax.

Although in many cases the raw fibres undergo drastic chemical treatment before spinning, the food substances required by the cellulose-destroying bacteria may easily be reintroduced into the manufactured products, for instance with polluted water. The reinfection of cellulose fabrics exposed to humid conditions is, therefore, highly probable.

LEE (H. A.) & SERRANO (F. B.). **Banana wilt of the Manila Hemp plant.**—*Phytopath.*, xiii, 5, pp. 253–255, 1923.

A disease of Manila hemp, attributed to bacterial infection, was described by Reinking (*Philipp. Journ. Sci.*, xiii, p. 221, 1918) as 'abaca heart rot'. It has recently been increasingly destructive in Laguna and Cavite, Philippine Islands. A species of *Fusarium* was isolated from a large proportion (60 per cent.) of the diseased material, especially in the early stages. Several strains of bacteria were also isolated, three being more frequently encountered than the others. Inoculations with the *Fusarium* gave positive results in 66·41 per cent. of the attempts, whilst inoculations with the three bacteria above mentioned were successful only in 5, 10, and 6 per cent. of the cases respectively. A comparison between the hemp *Fusarium* and *F. cubense* isolated from diseased bananas in the Philippines revealed neither cultural nor morphological differences, and for the time being the two organisms must be regarded as identical though the hosts are affected differently.

F. cubense isolated from wilted bananas and inoculated into the growing central cylinder of the hemp plant produces a typical heart rot, entirely different from the banana wilt. On the other hand, banana plants inoculated with the Manila hemp *Fusarium* showed typical wilt symptoms.

The selection of disease-resistant varieties appears to offer the best prospects of control.

Dowson (W. J.). **Contributions from the Wisley Laboratory. XII. The wilt disease of Michaelmas Daisies.**—*Journ. Roy. Hort. Soc.*, xlviii, 1, pp. 33–57, 8 pl., 1923.

This is a more detailed account of the wilt disease of Michaelmas daisies briefly described in a previous paper [see this *Review*, i, pp. 384, 385].

The first conspicuous symptom of the disease, which is increasing in prevalence owing to the distribution of infected stocks, is noticeable about the end of May and consists of a bright lemon- or orange-coloured mottling of the lower leaves, which finally become brown and shrivelled. The early production and continued growth of suckers is another marked characteristic of the disease.

Microscopic examination of a typically affected plant, in which the stems were dead almost to the base, revealed the mycelium of the causal organism in all the dead stem tissues, especially those of the wood. At the base of the plant, however, hyphae were present only in the older xylem vessels. The suckers, the majority of the roots, and part of the cortex of one of the rhizomes were the only parts free from mycelium. In all the invaded areas a large number of tracheids and vessels were plugged with a brown substance and were sometimes visible to the naked eye as dark streaks in the wood.

Examination of other similar material also showed the mycelium in the living wood of the basal portions of diseased plants. The water-conducting tissues were preferred, but on the death of these the pith and cortex were also invaded. Many of the hyphae penetrated the pits in the walls of the vessels and passed through to the tracheids in a radial direction. The medullary rays were not invaded. Close behind the advancing edge of the mycelium most of the xylem contained hyphae, and sometimes spore-like bodies, the nature of which is not known. The fungus produces visible symptoms in the host tissues at some distance in advance of the mycelium.

The pathogen was isolated from diseased plants, and inoculation experiments [which are described in detail] carried out in 1921 and 1922 gave successful results. The symptoms artificially produced resembled those observed in the garden. Plants inoculated early in the season were partially or entirely prevented from flowering, while those inoculated late were only slightly affected. There were some indications of varietal susceptibility, Climax being more quickly and severely infected than Gladys Donellan.

As regards the control of the disease it was shown that by striking cuttings taken from the tips of the suckers a large number of healthy plants could be raised from diseased stock. Cuttings taken from diseased plants which had been kept moist through the dry weather made little growth, and some actually developed the disease.

In order to ascertain whether the symptoms of wilt disease could be produced by a purely mechanical plugging of a certain area of the xylem, large wedge-shaped pieces were removed from lilac and privet shoots, the cut surfaces being rubbed with vaseline and bound over with tin foil secured with string. There was not the slightest sign of wilting, the turgidity of the foliage being

unaltered and the transpiration current maintained. In another experiment the liquid filtrate of a culture of the organism causing the disease was slowly introduced into a Michaelmas daisy plant by means of a tube, the fine orifice of which was pressed into a small hole in the stem. By the end of the month all the leaves above the point of insertion showed the typical symptoms of the disease.

The morphological and cultural characters of the fungus, which grew best on sterilized aster stems in a little water, are described. The hyphae are hyaline, 1 to 3 μ in diameter, nearly always containing numerous oil drops, and often running parallel for some distance. The conidiophores are generally short (10 μ), swollen, lateral hyphae, but may be terminal without the swelling. The conidia are 4 by 1·5 μ, continuous, with rounded ends, and abstricted one at a time. At first they are held together in a clump of about twenty, but later the clumps collapse and the conidia lie round the hyphae, the conidiophores constantly producing fresh supplies.

These characters correspond with those of the genus *Cephalosporium* Corda, which includes many microconidial stages of species of *Fusarium*. In the present case, however, there has been no indication of a *Fusarium* stage and the fungus is accordingly named *Cephalosporium asteris* n. sp., a Latin diagnosis being given.

Cook (M. T.). **A disease of Dahlias.**—*Phytopath.*, xiii, 6, p. 285, 1923.

A mild disease of Snowdrift and Shasta white dahlias at the New York Botanical Garden in 1922 was found to be due to *Sclerotinia libertiana*. The stems exhibit a water soaked appearance, accompanied by wilting of the affected parts, which later turn black and die. The mycelium and large sclerotia were found filling the central cavities of the stems.

Lobik (A. T.). К вопросу о влиянии паразитных грибков на урожаи клевера. [On the question of the influence of parasitic fungi on Clover crops.]—'*Plant diseases*', *Journ. Centr. Phytopath. Stat. Chief Bot. Gard. Russian Republic*, xi, pp. 2–8, 1922.

Observations and measurements made by the author in 1915 indicate that of the parasitic fungi attacking cultivated clover in the province of Riazan, namely *Peronospora trifoliorum*, *Erysiphe polygoni*, *Phyllachora trifolii*, *Botrytis anthophila*, *Phyllosticta trifolii*, *Uromyces trifolii*, and *Gloeosporium caulivorum*, the two last-named have the most definite influence on the host plant. In the majority of cases *Uromyces trifolii* was observed to stimulate the vegetation of the plants attacked, resulting in a heavier production both of green parts and of seed. Anthracnose (*Gloeosporium caulivorum*) was found to be the only serious disease, both because of its widespread distribution all over the province and from the considerable reduction it caused in the production of fodder and seed. With the exception of *Botrytis anthophila*, the above-named fungi do not seem to have any influence on the germinative power of the seed, and there are indications that these fungi are not transmitted by seed.

Adam (D. B.). **Experiments in the storage of fruits.**—*Journ. Dept. Agric. Victoria*, xxi, 3, pp. 178–186; 4, pp. 234–241; 6, pp. 371–382, 2 figs., 1923.

Among the physiological changes in fruit which result in cool storage loss is the blackening of the skin of pears. The results of experiments showed that Kieffer pears stored in specially controlled experimental chambers at temperatures of 34° and 37° F. were more liable to blackening than those stored at 32° F. The degree of maturity is another important factor in this storage trouble, which may be controlled to some extent by early picking, when the pears are still green. Wrapping was found to exert no appreciable influence on the occurrence of the disease. Bourquelot and Fichtenholz (*Journ. Pharm. Chem.*, ii, pp. 97–104, 1911) have isolated a phenol glucoside, arbutin, from the leaves and surface layer of the fruit of many varieties of pears. It is suggested that the blackening of the fruit in storage results from the hydrolysis of arbutin to glucose and hydroquinone and the oxidation of the latter substance to quinone and water. The writer's attempts to isolate arbutin from unblackened Kieffer pears that had been in storage for some months were not successful, possibly because the substance had been already converted into hydroquinone, which could not be oxidized in the absence of injury to the cells. The most susceptible varieties, besides Kieffer, were L'Inconnu, Madame Cole, Vicar of Winkfield, and Beurré Bosc.

Flesh collapse is particularly severe in fruit from young trees and in the Winter Cole variety; such fruit should be removed from storage at 32° F. not later than 1st July [in Victoria].

Considerable losses in cool storage are caused by the fungi *Penicillium glaucum*, *Sclerotinia cinerea*, and *Botrytis cinerea*, the mycelium of the last-named often forming a 'nest' round the rotten pears. The results of examination of pears stored under different systems of refrigeration (a brief technical account of which is given) and at different temperatures are described. Winter Coles, stored 25th March and inspected 7th July 1922, gave: (*a*) average percentage sound at 32° F. 67; at 34° F. 70; at 37° F. 53; (*b*) average percentage sound under direct expansion system 70, air circulation system 60, combined systems 56. At 34° F. there was no difference in the percentage of mouldy fruit under the various systems of refrigeration. The best results were got when every layer of fruit was wrapped. Winter Nelis pears from irrigated plots kept as well as those from unirrigated plots. With this variety there were found to be 90 per cent. free from mould at 32° F., 67·5 per cent. at 34° F. and 82 per cent. (one case only was tested) at 37° F. The percentage of sound fruit in grade $2\frac{1}{4}$ inches was 88 per cent.; $2\frac{1}{2}$ inches 75 per cent.; and $2\frac{3}{4}$ inches 68 per cent.

The results of cool storage experiments with Rome Beauty apples kept in the chambers for nine months showed that scald develops primarily on immature fruit stored at relatively high temperatures and inadequately ventilated. Mature Rome Beauty apples from 30 year old trees showed no trace of scald under various conditions of temperature and refrigeration, and this appears to be the most usual experience. With Rymer apples, however, the more mature individuals suffered most from scald.

Brooks and his collaborators in the United States believe scald to be produced by the exhalation of gases other than carbon dioxide from the fruit [see also this *Review*, ii, p. 456]. Apples placed by the author in a closed container with ethyl malonate developed typical scald injury. The mature samples in this case also were the most susceptible. The varieties Granny Smith, Dunn's, and Yappeen Seedling were more resistant than Jonathan (which is notoriously the most susceptible variety to this form of injury), Five Crown, and Rome Beauty. Hard varieties, such as Stone Pippin, are not so deeply penetrated by scald injury as soft apples like Jonathan.

Jonathan spot occurs chiefly on mature apples of the Jonathan and Scarlet Nonpareil varieties. The diseased areas are circular, brown patches, $\frac{1}{8}$ to $\frac{1}{4}$ inch in diameter, in the centre of which is a darker portion, the lenticel. In some cases the area immediately surrounding the lenticel remains green, encircled by a fairly regular brown ring. The affected areas of cells collapse. Norton has shown (*Phytopath.*, iii, p. 99, 1913) that formalin and ammonia produce an injury similar to Jonathan spot. No apparent connexion could be traced between either the temperature or the refrigeration system and the development of Jonathan spot, for which no specific cause has yet been found.

It is of great importance to pick apples at exactly the right degree of maturity, since premature gathering results in scald, while fruit left too long on the trees is apt to develop Jonathan spot.

Internal breakdown or flesh collapse of apples [see this *Review*, ii, pp. 268, 316] may be divided into two types: (*a*) where the cells not only turn brown, but also become more easily dissociable on the application of pressure and the apple becomes partially or wholly soft so that the trouble can be diagnosed without slicing the fruit; and (*b*) where the cells become brown, but are not so readily dissociable as in (*a*) and the apple remains firm so that the symptoms are not noticeable unless the fruit is divided.

Investigations showed that a storage temperature of 37° F. gave the best results as regards freedom from internal breakdown; 32° F. is too low, especially for fruit grown on rich, moist, level ground, or particularly liable, for some constitutional reason, to tissue collapse. Rokewood and Rymer apples are each susceptible in a particular manner to storage conditions, the former showing a tendency to general and the latter to a localized core browning after long storage at 32° F. The similarity between this last condition and 'brown heart', believed to be due to the accumulation of carbon dioxide [see this *Review*, ii, p. 124], is worthy of notice since the conditions under which it appeared in certain cases were such as to preclude the development of the concentration of carbon dioxide believed to be necessary to cause brown heart. The various conditions require to be studied in relation to one another.

Bitter pit was present in only one of the experimental consignments, consisting of Dunn's apples. The disease was more prevalent at 34° F. than at 32° F.

Wilting in storage may cause considerable losses among susceptible varieties of apples, e.g. Scarlet Nonpareil and Dunn's. The disease

was found to be more severe at a temperature of 34° than at 32° F., and to affect immature and fully mature fruit, especially the former, more than that picked at an intermediate stage (i.e. when light green in colour). There may be a loss of weight ranging from 2·2 to 3·5 per cent. after four months' storage.

Mould injuries also cause losses to apples in cool storage, and the following organisms were isolated from affected fruit: *Penicillium glaucum*, *P.* sp., *Venturia inaequalis*, *Sclerotinia fructigena*, *Gloeosporium* sp., *Cladosporium* sp., *Pleospora* sp., and *Botrytis cinerea*. The last-named, under favourable conditions, may become serious, one infected apple causing widespread decay in a case. Many of the organisms can only penetrate the injured skin of the apple. The tender Jonathan variety is particularly susceptible to mould attacks. Much of the damage due to these fungi may be prevented by wrapping. With hard varieties, such as Sturmer, Stone Pippin, Granny Smith, and Rymer, the wrapping of alternate layers suffices. It was observed that *Venturia inaequalis*, the cause of black spot [scab], grows and produces conidia on the surface of the fruit at 32° F.

Notes are given on the keeping qualities or 'commercial life' in storage at 32°–34° F. of a number of the chief varieties of pears and apples grown in Victoria. For general storage purposes a temperature of 34° rather than 32° F. is recommended for apples. A useful summary of practical recommendations is appended.

ALCOCK (Mrs. N. L.) **A die-back in Sussex.**—*Trans. Brit. Mycol. Soc.*, viii. 3, p. 190, 1923.

Boughs of winter Pearmain and Lane's Prince Albert apples in the Chichester district have become affected with a bark disease caused by *Diplodia griffoni*, which also occurs in France and New Zealand as a bark parasite of apples. The disease was stated to be causing a die-back and was being treated by cutting out the affected boughs. A brief diagnosis of the fungus is given.

THOMAS (R. C.). **A new fruit spot of Apples, Brooks' spot.**—*Ohio Agric. Exper. Stat. Monthly Bull.*, viii, 5–6, pp. 91–96, 2 figs., 1923.

The fruit spot of apple, caused by *Phoma pomi*, is beginning to give considerable trouble to Ohio fruit growers. The symptoms vary considerably on different varieties, but on Jonathan and Baldwin (two of the most susceptible) they are very similar; the infected areas are shaded deep green and sooner or later are covered with black specks. This feature of the disease is liable to confusion with fly speck [*Leptothyrium pomi*], from which it must be carefully distinguished.

An examination of the underlying tissues shows an abnormal thickening and browning of the cell walls of the sub-epidermal layers. Some of the cells appear to collapse, forming a cavity which often results in a sinking in of the epidermal layer. The surface spots are seldom more than one-quarter of an inch in diameter (generally less), and the invaded area the same depth. The incubation period varies from two weeks to two months.

The greatest damage caused by this disease is the spotting of the

fruit, which is frequently rendered unmarketable. In cold storage there is practically no development of the fungus, but spots frequently appear on fruit kept in cellars even though they may have looked quite sound at picking time.

In culture the fungus develops rapidly at temperatures varying from 55° to 70° F. Low temperatures retard growth but do not destroy the fungus. Isolations have frequently been made from infected fruits stored for several months at a temperature just above freezing point. Other workers have found that the vitality of the fungus is not impaired even at such low temperatures as $-40°$ to $-80°$ F. The organism is thus capable of withstanding the most rigorous Ohio winters, and its luxuriant growth on leaf mould suggests its probable winter habitat.

P. pomi also attacks the quince, on which it produces symptoms similar to those described above.

Some 25 varieties of apples, besides Baldwin and Jonathan, are susceptible to Brooks's spot, including Rome Beauty, Greening, Northern Spy, Red Astrachan, Russet, Gravenstein, Grimes Golden, Wealthy, Ben Davis, and Delicious. The occurrence of the disease is general throughout the State, the most severe losses in 1922 being reported from the south and east. Infection takes place principally in early and middle summer. Repeated attempts to inoculate fruit at storage time gave negative results, possibly on account of changes in the malic and tannic acid content of the cell sap.

Spraying tests carried out in 1922 for the control of scab [*Venturia inaequalis*] threw an interesting sidelight on the fruit spot problem. Four applications were given, on 19th April, 12th May, 12th June, and 25th July, Bordeaux mixture, lime-sulphur, and the Corona substitute spray (very similar to self-boiled lime-sulphur) being used in the tests. A control tree, which remained unsprayed throughout the season, showed 60 per cent. of infection by *P. pomi*. The trees sprayed with lime-sulphur were infected to the extent of 19 per cent., while those treated with Bordeaux had less than 1 per cent. of disease.

CHUPP (C.) & CLAPP (GRACE L.). **Fusicoccum canker on Apples.**—*Phytopath.*, xiii, 5, pp. 225–229, 1 pl., 1923.

In February 1921 young Duchess of Oldenburg apple trees were found affected with black cankers at or near the bud unions and occasionally farther up the stem. The cankers were smooth externally, not depressed, and the tissues (including the sap wood) discoloured under the bark. Superficially the symptoms resembled those caused by *Bacillus amylovorus*, especially as pycnidia of the causal fungus were seldom produced until the host had been killed.

The fungus, a species of *Fusicoccum*, was readily isolated and in culture produced stromata, in the cavities of which hyaline one-celled, cylindrical conidia, and thin, long, hyaline scolecospores were borne.

Some difficulty was experienced in regard to the systematic position of the fungus, which closely resembles *F. viticola* Reddick. Cross-inoculation experiments with *F. viticola* on apple and with

the apple *Fusicoccum* on grape, however, gave negative results. This fact, together with certain cultural differences, seemed to justify a distinction between the two species. Oudemans' brief description of *F. malorum* also suggested a possible identity, but no material of this fungus could be obtained for comparison, and it was therefore considered better to create a new species, *Fusicoccum pyrorum,* for the authors' fungus. [No mention is made of the Marchal's work with *F. malorum* (see this *Review*, i, p. 63) in which it is shown to be the pycnidial stage of *Diaporthe perniciosa,* the cause of a serious fruit tree canker.] It is believed to attack trees which have been injured or weakened by exposure to unsuitable conditions, and can probably be held in check by maintaining the trees in a vigorous state and free from injuries.

BIRMINGHAM (W. A.). **'Sour-sap' of fruit trees.**—*Agric. Gaz. New South Wales,* xxxiv, 6, pp. 431–437, 4 figs., 1923.

Since 1918 a disease of apples, pears, peaches, plums, nectarines, and apricots, attacking trees of all ages from four years upwards, has been reported from a number of districts of New South Wales and appears to be steadily increasing.

The typical symptoms of the disease are the following. In spring many buds on one or more branches either fail to break or only give poor growth, the affected limbs, owing to lack of foliage, becoming scorched and the bark reddish-brown in colour or even blackened, and invaded by saprophytic fungi. The disease may be confined to one or more branches or may be general throughout the tree. A sour, fermenting smell from the cut bark of recently dead limbs is noticeable, and discoloration of the tissues of the apparently normal roots is due to the presence of gum. The disease has probably existed for many years, but has been mistaken by growers for fireblight [*Bacillus amylovorus*]. It is known in America as winter kill or spring injury.

All attempts to isolate a causal organism have failed and the disease appears to be due to some physiological disturbance. Neither the type of soil nor drainage is responsible for the trouble, since it occurs on sandy, alluvial, and heavy clay soils, and on well-drained soils, but there is some evidence that extreme weather conditions may be responsible. An outbreak in the Camden district in 1918 followed excessive rain, and in 1920 the disease occurred on pear trees at Kurrajong after a period of drought following heavy rains. Nitrogen starvation has been put forward as the cause, but the soil at Camden, although acid, showed no abnormal deficiency of nitrogen.

No improvement in the condition of the affected trees resulted from treatment with lime, farmyard manure (together and separately), nitrate of soda, muriate of potash, or sulphate of iron.

In 1920 the disease was reported from the Richmond district, and whilst chemical analysis showed that the average nitrogen content of the soil round affected trees was lower than that at the base of healthy trees (0·082 per cent. compared with 0·117), the difference was not considered sufficient to explain the diseased condition.

The following is a list of some of the susceptible varieties. Apples: Granny Smith, Gravenstein, London Pippin, Jonathan, and

Russet. Pears: Williams, Packham's Triumph, and Josephine de Malines. Peaches: Elberta, Brigg's Red May, Hales' Early Triumph, Globe, Californian Cling, and Red Italian. Goldmine nectarines are also susceptible. The varietal behaviour of apricots has not been studied.

CIFERRI (R.). **Note sperimentali sul 'mal del piombo'.** [Experimental notes on the silver leaf disease.]—*Riv. Pat. Veg.*, xiii, 1–2, pp. 1–9, 1923.

In this paper the conclusion is reached that apart from cases of silver leaf of fruit trees due to the attack of *Stereum purpureum* and also those caused by insect injury, others occur of non-parasitic origin, which appear to be connected with profound physiological disturbances in the plant.

Petri (*Ann. R. Inst. Sup. For. Naz., Florence*, ii, p. 467, 1916–17) determined the presence in the autumn of numerous crystals of calcium oxalate in the silvered leaves of a three-year-old peach tree which had been headed back in the preceding spring. He considered that the cutting back had resulted in a larger production of oxalic acid, and that the latter was a temporary phenomenon disappearing after the next vegetative period. In other cases he ascribed the silvering to the hydrolysis of the pecto-cellulose layer below the cuticle of the leaf through the action of a pectinase in response to external stimuli.

In the observations made by Ciferri on newly silvered peaches and plums, no parasite could be found nor was calcium oxalate present in excess, though the affected leaves were distinctly more acid than healthy ones and it is possible that an increase in oxalic acid, not yet precipitated by lime, had taken place. Hydrolysis of the calcium pectate of the subcuticular layer of the upper epidermis occurred in the silvered leaves as described by Petri; tests were accordingly made for the presence of a hydrolysing enzyme and this was found in much greater quantity in the silvered than in healthy leaves.

McCLINTOCK (J. A.). **Peach rosette, an infectious mosaic.**—*Journ. Agric. Res.*, xxiv, 4, pp. 307–315, 10 pl., 1923.

In 1919 the writer began a series of investigations on peach rosette, which is very prevalent in Georgia where it was first observed in 1881, afterwards spreading to various other States.

It was shown that healthy peach and apricot buds inserted into the new growth of apparently normal branches on a rosetted seedling peach tree, developed the typical symptoms of the disease. The apricot buds produced shoots two to three inches in length, the leaves of which had a mottled appearance like that due to mosaic diseases. The insertion of peach buds from rosetted shoots into healthy peach trees resulted in the contraction of the disease by the latter, the controls inoculated with healthy buds remaining free from infection. Buds from a rosetted peach tree inserted into a healthy Royal apricot seedling developed the disease, slight symptoms of which—a shortened internodal growth and mottled leaves—also appeared on the apricot stock. Two diseased apricot buds inserted into a peach seedling produced the typical symptoms

of the disease in the latter. These experiments prove that the causal entity of rosette is identical in the peach and apricot, though somewhat dissimilar in its external manifestations.

A Moorpark apricot seedling into which rosetted peach buds were inserted showed severe symptoms of stunting, the maximum growth of any one branch in the summer of 1921 being five inches, while an adjacent healthy tree grew 4 feet 9 inches.

Further experiments on the same lines demonstrated that rosette was transmissible from peach to Blue Damson and Red June plums and back to peach; from peach to wild Chickasaw plums and vice versa; from wild Chickasaw plums to Red June plums; from peaches to Mazzard cherries, on which the symptoms differ slightly from those on the peach; from wild plums to bitter almonds; from apricots to bitter and Texas seedling almonds; and from almonds to peaches. All attempts to produce the symptoms of rosette in Marianna plums gave negative results, this stock not only being immune itself but also reducing the virulence of the causal entity in the susceptible peach and Maynard plum scions. The results of a further test, involving the insertion of buds from a healthy Mayflower peach into the new growth of Marianna stock on which a rosetted Maynard plum shoot was growing, indicated that the causal entity does not pass from one susceptible host to another through the tissues of a resistant stock.

In September 1919 two six-year-old peach trees which had developed rosette in the previous spring were dug up and replaced, in the following January, by healthy one-year-old seedlings, no attempt being made to remove the fragments of the diseased roots. The transplanted trees made satisfactory progress and showed no symptoms of rosette, thereby indicating that the disease is not transmitted by the soil.

In no case was it possible to transmit the disease by means of sap transfers from affected to healthy trees, or by removing suspected insects, especially the black peach aphis (*Anuraphis persicae niger*), from rosetted trees and caging them on healthy ones. An animal, as yet undetermined, however, is believed to be the chief agent of transmission.

CZARNECKI (HELEN). **Studies on the so-called black heart disease of the Apricot.**—*Phytopath.*, xiii, 5, pp. 216–224, 1 pl., 4 figs., 1923.

In 1916 a disease of the apricot, manifesting itself in a wilting of the foliage and discoloration of the wood, was investigated in various localities in California, where it had apparently been established for some years. In one district almond trees were similarly affected. The disease occurred most frequently on three- to six-year-old trees heavily irrigated during the summer and inter-cropped with tomatoes, both younger and older trees, however, being occasionally attacked. On nursery seedlings the disease occurred in blocks, the adjoining groups of trees being healthy.

The first symptoms were observed early in June, when the apical leaves of one or more branches of a tree wilted, turned yellow, and finally fell. The wilting progressed in a downward direction and

gradually involved the entire branch. Partially or totally defoliated branches often produced a pale yellow, new growth later in the season.

Sections through wilted branches revealed a brown to black discoloration extending right down into the base of the trunk and often into the main root, the laterals, however, being unaffected. The sudden wilting of the branches was evidently due to the formation of gum in the xylem vessels and the cutting off of the water supply.

Pure cultures of a *Verticillium*, believed to be a new species, were obtained on various nutrient media from diseased apricot and almond trees and from apricot and Myrobolan seedlings. The morphological and cultural characters of the fungus are described. In liquid nutrient broth a characteristic flaky growth is first produced, and later a pellicle is formed on the surface, which contains sclerotial masses consisting of dark, vacuolate, short cells. On agar cultures an even, embedded growth, with few conidiophores, was obtained, which later produced sclerotial masses. The results of inoculation experiments on one-year-old branches of a five-year-old seedling apricot gave positive proof of the pathogenicity of the fungus.

Black fruiting bodies, 0·5 to 1 mm. in diameter, and similar to the sclerotial masses produced in culture, were formed in the winter on dead twigs of affected trees. From the surface of these bodies short, solitary conidiophores, bearing conidia at the apex, were produced. The isolation of the fungus from these bodies was hampered by contamination with *Cladosporium*, but eventually the typical *Verticillium* was obtained.

Probably the best method of control will be the excision of wilted branches, or, if necessary, the removal of the affected trees in the autumn, in order to prevent spore infection the following year from the fruiting bodies on dead twigs.

SIEGLER (E. A.) & JENKINS (ANNA E.). **Sclerotinia caruncuIoides, the cause of a serious disease of the Mulberry (Morus alba).**— *Journ. Agric. Res.*, xxiii, 10, pp. 833–836, 2 pl., 1 fig., 1923.

A disease of the mulberry, manifested by the development of 'peculiarly enlarged portions of the aggregated fruit', was described by Orton (*Exper. Stat. Rec.*, xiv, 6, p. 531, 1903) and was said to occur in Georgia, Alabama, and Mississippi. Since that time specimens of similarly affected mulberry fruits have been received from various southern states by the United States Department of Agriculture, while Taubenhaus has described the condition in Texas under the name of 'popcorn' disease (*Nature Study Rev.*, xvii, 7, p. 282, 1921).

Specimens of diseased mulberry fruits received from South Carolina in July 1920 [see this *Review*, i, p. 387] showed a greatly enlarged condition of the ovary, and the calyx lobes were small and non-succulent instead of being fleshy as in the normal fruits. Microscopical examination showed the ovaries to be completely filled with mycelium, the compact hyphae of which produced a typical sclerotium, thus preventing the formation or further development of the drupelets. A layer of sporogenous hyphae in a compact palisade completely enveloped this sclerotium and pro-

duced small, hyaline spores within the ovary wall. The spores, presumably microconidia, were exuded in immense numbers and collected in a wax-like mass on the outside of the ovary wall. It is stated that there has been no previous reference to microconidia of *Sclerotinia* occurring in nature [but see Wormald, *Ann. Appl. Biol.*, vii, 2–3, p. 176, 1920, and *Trans. Brit. Mycol. Soc.*, vii, 4, p. 287, 1922]. The disease is undoubtedly identical with that described by Orton.

In March 1921 the affected plantation was inspected and apothecia of a species of *Sclerotinia* found in large numbers beneath the affected trees. The apothecia were attached to ovaries, which were buried at an average depth of half an inch in the soil. The mature ascospores germinated in tap water. At this time there was found to be practically 100 per cent. of blossom infection. Specimens of young blossoms, at least 8 ft. above the nearest group of apothecia, were examined and typical ascospores found on the pistils. These observations are regarded as sufficient evidence of the pathogenicity of the fungus.

The causal organism differs in several respects from *Sclerotinia shiraiana,* which produces a somewhat similar disease in Japan. Particulars of these discrepancies are given and the name *S. carunculoides* proposed for the new species, which is characterized by the presence of small projections on the concave surface of the spore. These bodies are composed of two parts, one adjacent to the spore, crescent-shaped in transverse section, and a second adjoining the first and more or less hemispherical. Somewhat similar structures have been observed in *S. megalospora* and *Peziza cucullata.* The name *Spermatomyces mori,* suggested by Orton, was not accompanied by a technical description, and must therefore be considered a *nomen nudum.* A diagnosis of the fungus in English and Latin is given.

BRISLEY (H. R.). **Studies on the blight of Cucurbits caused by Macrosporium cucumerinum E. & E.**—*Phytopath.*, xiii, 5, pp. 199–204, 3 figs., 1923.

In 1921 the cantaloupe and watermelon crops in Arizona were almost complete failures, largely owing to a leaf blight caused by *Macrosporium cucumerinum.*

The first noticeable symptom of the disease, which usually starts about the middle of the growing season, is the development of a minute, tan-coloured spot at the point of invasion. Ultimately the spots enlarge, merge together, and kill the leaf. The enlarged spots are composed of concentric, darker rings, the small tan spot remaining at the centre. On the cantaloupe the spots are light brown and on watermelon almost black, but the infection point at the centre remains constant in colour. On over-ripe fruit sunken spots, one-fourth to one inch in diameter, appear, later becoming covered with a dark, olive-green growth of spores.

The organism was readily isolated on prune agar poured plates, and the disease reproduced on squash and cucumber leaves in a series of 16 inoculations. Pure cultures were made from one of the diseased leaves and a further 158 inoculation tests carried out. Ninety-six per cent. of the cantaloupe inoculations, 95 per cent. of

the squash, 92 per cent. of the watermelon, 70 per cent. of the cucumber, 50 per cent. of the potato, and 40 per cent. of the tomato were successful. It was found impossible to infect stems, petioles, or roots. The incubation period ranged from three to twelve days in the cucurbits and twelve to fifteen days in the potato and tomato. Turnips, cabbages, beans, and oranges were not susceptible.

The cultural characters of the organism, which grows rapidly on a slightly acid medium, are described. The results of investigations indicated that the mycelium overwinters in the dried tissue, the only function of the spores apparently being dissemination during the growing season. The minimum temperature for the development of the fungus was 3° C., the maximum 45° C., and the optimum 30° C.

STAKMAN (E. C.) & LAMBERT (E. B.). **Dusting seed grain to prevent smut.**—*Univ. Minnesota Agric. Ext. Div. Spec. Bull.* 70, 12 pp.; 1 fig., 1923.

The results of experiments carried out in 1921 and 1922 at University Farm, St. Paul, and four sub-stations in Minnesota, showed that bunt of wheat [*Tilletia tritici*] and the smuts of oats [*Ustilago avenae* and *U. levis*] were effectively controlled by chemical dusts, three of which were extensively tested, namely, copper carbonate, a mixture of anhydrous copper sulphate and lime [proportions are not given], and a proprietary compound 'Seed-O-San' prepared by the Standard Tester Company, of Chicago. Two oz. will treat one bushel of grain. The best results were obtained with copper carbonate, which was effective in practically eliminating smut in all but such heavily infected seed lots as were unfit for seed purposes under any circumstances. This dust also caused rapid and vigorous germination of the seed, which resulted in increased yields as compared with grain treated with formalin or untreated. The copper sulphate and lime mixture was not so generally satisfactory, while the chief value of Seed-O-San lies in its power to stimulate germination of the seed to even a higher degree than copper carbonate, but it does not control smut so well as the other dusts. The writers suggest that the dusts will also be found to control the covered smut of barley [*U. hordei*], flag smut of rye [*Urocystis occulta*], kernel smut of sorghum [*Sphacelotheca*], and millet smuts, and experiments are being made to test this.

The main advantage of treating seeds with chemical dusts as compared with formalin lies in saving time and labour, in being able to treat the seed at any time before sowing, as it has been found that the dust retains its effectiveness even when applied six months before the seed is sown, and in avoiding all injury to the seed such as occurs when formalin is used. The use of dusts in place of formalin is therefore recommended, and detailed practical instructions are given for their application.

NOWELL (W.). **Diseases of crop-plants in the Lesser Antilles.**—xix + 383 pp., 1 col. pl., 150 figs., 1 map. London, The West India Committee, Trinity Square. 1923.

This is much more than a book on the specific crop diseases of

a small group of islands. It might indeed, as stated in the 'foreword' contributed by Prof. J. Bretland Farmer, perhaps be more correctly designated as a treatise on the principles of plant pathology with special reference to the diseases occurring in the West Indies. It deals with the subject on a much wider basis than is customary in works of this nature, discussing especially fully the relation of the host plants to their environmental conditions and the influence of these latter on their diseases. To produce an economic plant pathology, the author holds that the mycologist must become an agriculturist, and that with a knowledge of the fungus and of the disease which it produces, must be combined a knowledge of the crop which it attacks.

The book is divided into two parts, one dealing with the nature and classification of plant diseases and their prevention and control, and the other giving an account of the more important diseases found in the Lesser Antilles. In the former, chapters are given to diseases caused by fungi, bacteria, infective viruses, phanerogamic parasites, and nematodes, as well as on the relation of insects to plant diseases, on non-parasitic diseases, and on entomogenous fungi. Control measures are regarded both from general considerations and the specific application of preventive and remedial measures. In the second part of the book there is a valuable survey of agricultural conditions in the islands, followed by a general consideration of root and of stem and leaf diseases, the rest of the book being devoted to a description of the specific diseases of cacao, coco-nut, citrus, coffee, rubber, minor fruit trees, bananas, cereals, cotton, sugar-cane, root crops, leguminous plants, &c. The characters of each disease are fully described, together with its distribution in the islands and references to its occurrence elsewhere and the conditions under which its development is fostered or hindered. Brief details of the microscopic characters of the parasite are also given, and also the appropriate means of control and their practical application. Most of the important diseases are illustrated from photographs which convey an excellent impression of their naked-eye characters, and in some cases the microscopic details of the parasite are also figured.

The book is one which is indispensable to all plant pathologists concerned with the diseases of tropical plants, and will also be found interesting and useful by a much wider circle of readers. As a planters' manual it should meet a definite need for a handy and authoritative work on the diseases of some of the chief tropical plantation crops.

Stakman (E. C.), Henry (A. W.), Curran (G. C.), & Christopher (W. N.). **Spores in the upper air.**—*Journ. Agric. Res.*, xxiv, pp. 599–605, 2 pl., 1923.

In connexion with rust-epidemiology investigations in the United States, attempts have been made to obtain information on the dissemination of spores by air currents and to correlate the data with the spread of rusts. During the spring and summer of 1921 spore traps (consisting essentially of microscopic slides smeared lightly with vaseline) were exposed on aeroplanes at various altitudes and at several places in the Mississippi valley.

Many spores of pathogenic fungi, conidiophores, pollen grains, glumes of grasses, and small insects were caught on the slides. Spores of *Puccinia*, *Alternaria* (by far the most numerous and sometimes in chains), *Helminthosporium*, *Cladosporium*, *Cephalothecium*, *Ustilago* (including one spore probably of *U. zeae*, with a promycelium and about twenty sporidia still attached), *Tilletia*, and *Scolecotrichum* were recognized.

Spores and pollen grains were relatively abundant up to about 11,000 ft., but at higher altitudes they were relatively scarce. Two spores, probably of *Puccinia triticina*, were caught at 16,500 ft.

Alternaria spores caught at altitudes from 3,000 to 10,500 ft. germinated readily. Uredospores and aecidiospores of *P. graminis* caught at elevations of 7,000 ft. and 1,000 ft. respectively also germinated.

Attempts were made in 1922 to get data regarding the spread of black stem rust [*P. graminis*] in Nebraska, Kansas, and Oklahoma. No spores were caught, however, until rust began to develop in the areas where the flights were made, and the number of spores in the air decreased rather rapidly as the distance from the rusted area increased. The aeroplane is considered to be a great aid in epidemiological studies and probably also in determining the value of establishing quarantine lines.

Brooks (F. T.) & Hansford (C. G.). **Mould growth upon cold-store meat.**—*Trans. Brit. Mycol. Soc.*, viii, 3, pp. 113–142, 10 figs., 1923.

Besides 'black spot' of chilled and frozen meat, which, in the authors' experience, was always due to *Cladosporium herbarum* [see this *Review*, i, p. 59], the following moulds were identified in the course of a systematic examination of consignments received from the southern hemisphere. *Thamnidium chaetocladioides* and *T. elegans* (growth profuse at 1° to 2° C., very slight at −6° C.); *Mucor racemosus*, *M. mucedo*, and *M. lusitanicus* (good growth at 1° to 2° C., no growth in two last-named at 30° C. but *M. racemosus* grew at this temperature, no growth but germination of spores of *M. mucedo* at −6° C.); *Penicillium expansum* and *P. anomalum* (former germinates and grows very slightly at −6° C., better at −1° C., and actively at 2° C.) and pink and white species of *Saccharomyces*, which develop with great rapidity at temperatures just above freezing point, but apparently do not grow below zero. In addition, two new species, *Sporotrichum carnis* and *Torula botryoides*, and the type species of a new genus, *Wardomyces anomala*, were isolated.

Several strains of *Cladosporium herbarum*, differing chiefly in growth characters, were encountered. *C. epiphyllum* and *C. aphidis* are considered to be strains of the fungus, while *Hormodendrum cladosporioides* is stated to be merely a spore form of it, which is produced under cultural conditions at low as well as high temperatures.

Sporotrichum carnis n. sp. occurs very frequently on stored meat in the form of innumerable white, slightly woolly patches, and is the commonest type of white mould known to the meat trade.

The growth of this fungus on meat is entirely superficial. Its morphology and cultural characters are described in detail. Growth is very slight at $-6°$ but good at $2°$ C. Several distinct strains were encountered but the differences did not affect the microscopic characters. A form of *Sporotrichum* indistinguishable from *S. carnis* has been found in slime fluxes of trees at Cambridge, and as a laboratory contamination in Denmark.

Torula botryoides n. sp., first isolated in May 1918 from a halibut kept in cold storage, was subsequently found to occur on meat, including rabbits and sausages, under similar conditions. It gives a greyish white, rather woolly growth, quite distinct from that due to *S. carnis*. Growth was very feeble at $-6°$, abundant at $2°$, and nil at $25°$ C. The systematic position of the fungus is obscure and it is referred to *Torula* with some hesitation.

Wardomyces anomala n. gen., n. sp. of the Dematiaceae, isolated from a white, slightly woolly patch of mould on a skinned Australian rabbit, was almost indistinguishable on the host from *S. carnis* but showed quite different microscopic characters. The genus is described as having a creeping, septate, hyaline mycelium, with short, branched, septate, hyaline, lateral conidiophores, the branches arising as successive lateral proliferations of the basal cells. The brown to black conidia are abstricted singly from the terminal cells of the conidiophores in lateral succession in groups, and are oval to spherical. In *W. anomala* the conidiophores are 15 to 25 μ long and the conidia 5 to 8 by 4 to 6 μ, smooth, and usually with slightly pointed ends.

The spores and young mycelia of several of the moulds studied, notably *Cladosporium*, *Thamnidium*, and *Penicillium expansum*, were found to retain their vitality for more than two years at $-6°$ C.

None of these moulds appears to render the meat unfit for human consumption. Even in 'black spot' the mycelium penetrates only to a maximum depth of 4 mm. Several of them are of common occurrence on vegetable and animal refuse and no doubt come from such material in the vicinity of the abattoirs in the southern hemisphere. Air-borne spores alight upon the carcases before and during storage and develop into mould growths at favourable opportunities. The latter can be restricted by proper attention to temperature and humidity conditions in cold storage, the duration of which should not be unduly protracted.

DITTRICH (G.). **Ueber Auftreten und Wachstumsbedingungen von höheren Pilzen.** [The appearance and growth conditions of higher fungi.]—*Ber. deutsch. Bot. Gesellsch.*, xli, 3, pp. 128–134, 1923.

The meteorological and other conditions governing the appearance and development of edible fungi was the subject of inquiry by a special commission during the war period in Germay.

Numerous instances are cited to show that saturation of the soil is an even more important factor than high temperatures in the development of fruit bodies. Heavy and continuous rain was found to promote the growth of various species at temperatures considerably below that usually regarded as the minimum (5° to

7° C.). It is pointed out that a short spell of frosty weather, though destructive to the fruit bodies already produced, does not prevent the formation of new ones.

The abundance of certain species in various years is discussed in relation to the prevalent weather conditions, and there are brief references to matters connected with mushroom cultivation.

Two cases are quoted of the regular occurrences of certain fungi in the vicinity of special trees. *Boletus elegans* in association with the larch [see this *Review*, i, p. 442] and *B. erythropus* exclusively under oaks. *Lactarius deliciosus* appears to be dependent on the age of the trees, being found in abundance in plantations of young firs and disappearing as soon as the latter reach a certain age.

The investigations seem to have been restricted to Breslau (Silesia) and its environs.

ZELLNER (J.). **Die Symbiose der Pflanzen als chemisches Problem. II Teil.** [The symbiosis of plants as a chemical problem, Part II.] — *Beihefte Bot. Centralbl.*, xl, Ab. i, 1, pp. 1–13, 1923.

The paper, a continuation of one published in 1912 (*Beih. Bot. Centralbl.*, xxviii, Ab. i, p. 473), opens with a classification of the phanerogamic parasites and saprophytes, which are divided into the non-chlorophyllous parasites and saprophytes, and the green holo- and hemiparasites, brief morphological and bibliographical notes on each species being given. The term symbiosis is used in the wider sense, to cover parasitism.

In the fungi there is no essential chemical difference between parasites and saprophytes and the same is true of the heterotrophic, non-chlorophyllous phanerogams. In both these groups there is the same necessity for the assimilation of ready-made organic nutriment in the shape of sugar or some other carbohydrate, this function somewhat resembling that obtaining in the animal kingdom. Substances have been found in fungi which are identical with, or closely related to certain animal products (e.g. urea, glycogen, cerebrosides, and chitin). This is due, not, as was formerly supposed, to the heterotrophic existence of the fungi, but to their systematic position near the border-line between the vegetable and animal kingdoms. The great difference between fungi and animals is that, whereas even the lowest forms of the latter possess a rudimentary digestive system which enables them to assimilate solid substances, the former are only capable of absorbing the finest emulsion of crystalloids or colloids, into which, by means of enzymes, they convert the otherwise insoluble components of their substratum.

Whereas phanerogamic parasites assimilate the nutrient substances from their hosts mainly by a process of gradual osmosis, fungous parasites act more rapidly and with greater force, other processes appearing to contribute to food transference. Thus resin and phlobaphene, in which many fungi are deficient, occur in large quantities in certain species inhabiting resinous trees and roots (e.g. *Polyporus officinalis*, *P. pinicola*, *Hypholoma* spp., *Panus stypticus*, *Hydnum ferrugineum*, &c.) and in those attacking

tannin-containing wood (e.g. *Polyporus igniarius*, *P. fomentarius*, and *P. hispidus*). Presumably these substances are absorbed by the parasite through the cell walls of the host in the form of fine emulsions.

The nutrient substances extracted from the host are either immediately assimilated into the circulatory system of the parasite, or deposited in certain organs as reserve material. The latter process is almost entirely restricted to phanerogamic parasites but occurs in a few of the lower fungi, *Endomyces* storing up fat and *Bacterium radicicola* glycogen and albumen.

As regards chemical composition there appears to be no similarity between non-chlorophyllous phanerogams and fungi. The mechanical tissue is feebly developed in both, the leaf and branch apparatus necessary for bearing chlorophyll being unnecessary and the plant tending to be soft, waxy, fleshy, and succulent, except in some Polyporaceae. The ratio of soluble to insoluble constituents is higher, therefore, in non-chlorophyllous plants than in those with normal mechanical tissues.

Non-chlorophyllous plants have a high water content, which is associated with the fact that the osmotic pressure of their cell sap is higher than that of the food solution received. Tests were made to determine the concentration of osmotically active substances (mineral salts, sugar, organic acids, soluble nitrogen compounds, &c.) in host plants, non-chlorophyllous phanerogams, and fungi. In the fleshy fungi there was a strikingly greater concentration of crystalloid substances as compared with the substrata; in the woody or leathery fungi this difference, though still apparent, was less striking; while in the non-chlorophyllous phanerogams the relations were obscure.

In all the non-chlorophyllous plants most of the mineral substances are present in a water-soluble form; an abundance of potassium and marked reduction of calcium were observed (magnesium, in the case of fungi, frequently being more prominent than calcium, and phosphoric acid also being present in large quantities). The acid content of the heterotrophic plants, both in free acids and organic acid salts, is generally higher than that of the autotrophic plants. An increase of sugar and sugar alcohols is frequently noticeable: heterotrophic phanerogams are mostly rich in dextrose, considerable quantities of mannite are present in the Orobanchaceae and fungi, and erythrite, volemite, and mycose occur in some of the latter. The content of non-albuminous, water-soluble compounds is augmented; in fungi the total nitrogen and soluble nitrogen contents are high.

The complete absence of starch in fungi is regarded as being a characteristic of their chemical constitution rather than a consequence of heterotrophy.

It is claimed that there is no evidence to prove the alleged capacity of plants to protect themselves against parasitic attacks by the secretion of toxins, enzymes, or the like which are absorbed by the parasite. On the other hand, parasites, especially fungi, possess the faculty in a high degree of giving off these substances to their hosts.

LEONIAN (L. H.). **The physiology of perithecial and pycnidial formation in Valsa leucostoma.**—*Phytopath.*, xiii, 6, pp. 257–272, 1923.

Valsa leucostoma appears to possess two strains, in one of which the mycelium, conidia, or ascospores are capable of giving rise to both perfect and imperfect stages, and the development of these can be controlled at will, while in the other, no matter what the environmental conditions may be, no perithecia are developed. Neither morphological nor physiological differences, however, were found between the two strains, which, for practical purposes, can be considered as identical. The ascigerous stage has been lost from the life-cycle of one of these strains and can probably not be restored by mere physiological modifications.

The strain used in a series of culture experiments on filter paper pads, the technique of which is fully described, was obtained from an ascospore, and produced pycnidia and perithecia if grown in a favourable nutrient medium. Conidia and ascospores showed identical physiological reactions to the various solutions used. The standard solution (No. 2) contained 1·5 per cent. of nutrients as follows: KH_2PO_4 1·2 gm., $MgSO_4$ 0·6 gm., peptone 0·6 gm., maltose 6·25 gm., malt extract 6·25 gm., and distilled water 1,000 c.c. No. 1 solution was a very dilute one, containing only 0·37 per cent. of nutrients, and No. 3 represented the highest concentration with a total of 24 per cent. of nutrients. It was found that the quantity of mycelium, pycnidia, and perithecia increased in direct proportion to the increase of food concentration, the time required for fruiting, however, being longer in the richer solutions. In a further test, in which cultures were repeatedly transferred at three-day intervals to a fresh supply of the standard nutrient solution, the mycelium, pycnidia, and perithecia attained a great increase in their development. A constant supply of food of approximately equal concentration results in a longer period of vegetative growth and delays reproduction, but induces much more luxuriant fruiting ultimately. When transferred from the standard food solution to distilled water, there was no appreciable difference in the quantity of fruit bodies formed, but when the mycelium was moved from a solution of high concentration to distilled water there was a sharp decrease in reproduction. When the mycelium was transferred from the standard solution to the high concentration of the same solution, pycnidia increased in number while perithecia decreased ; when the process was reversed the results were also reversed.

Three nutrient solutions were used in experiments in the control of perithecial and pycnidial formation. A was the standard solution already described, B consisted of the standard solution minus malt extract, and C was composed of 1 gm. ammonium nitrate, 0·5 gm. of dihydrogen potassium phosphate, 0·25 gm. magnesium sulphate, 5 gm. cane sugar, and 100 c.c. distilled water. Solution C, where carbohydrates were furnished by cane sugar and nitrogen by ammonium nitrate, was unable to induce the formation of either pycnidia or perithecia. When, however, the mycelium was grown in this solution and then transferred to A there was a noticeable increase in reproduction, which was suppressed when the process was reversed. When the mycelium

was grown in A, washed and transferred to C, and shortly afterwards re-transferred to A, pycnidia formed in great abundance while perithecia were suppressed.

When the fungus was grown in A until the perithecia formed, then washed and transferred to a fresh supply of the nutrient solution, perithecia gave rise, at their tips, to a new crop of perithecia, but no pycnidia developed.

When the fungus was grown in A until the perithecia formed, then washed and transferred to C, shortly afterwards being again washed and transferred to a fresh supply of A, perithecia gave rise, at their tips, to stromata with mature pycnidia, which eventually produced perithecia. The perfect fruiting bodies appeared as small, rostrate structures studded on globose stromata.

When the fungus was allowed to form a luxuriant mycelium, and then washed and transferred to the different food constituents of the standard solution (singly or in all possible combinations), no suppression of either type of reproduction took place.

When the mycelium, developed in the standard solution, was washed and transferred to M/8, M/16, M/32, and M/64 solutions of maltose, cane sugar, glucose, and levulose, it was found that the high concentrations checked perithecial formation; M/8 and M/16 concentrations of maltose, M/8, M/16, and M/32 concentrations of cane sugar, and M/8 concentrations of glucose and levulose hindered perithecial formation, while only the M/8 concentration of cane sugar inhibited pycnidial production. Levulose was found to be the most favourable of these sugars for perithecial development and the least for pycnidial production.

When the mycelium was developed in the standard solution, then washed and transferred to M/8, M/16, M/32, and M/64 concentrations of ammonium nitrate, calcium nitrate, sodium nitrate, and potassium nitrate solutions, perithecial formation was altogether inhibited. M/8, M/16, and M/32 concentrations of ammonium nitrate, and M/8 concentration of sodium nitrate, prevented pycnidial formation as well.

Solution B failed to induce reproduction. When the fungus was grown in this solution until an abundant mycelial development was obtained, then washed and transferred to 0·6 per cent. of malt extract for varying periods, and then washed and transferred to a fresh supply of B, it was found that one and five minutes' exposure to malt extract solution failed to induce reproduction; ten minutes' exposure induced pycnidia, and fifteen ninutes both pycnidia and perithecia. Longer exposures merely served to augment the number of fruit bodies formed.

HEMMI (T.). **On the relation of temperature to the damping-off of Garden-Cress seedlings by Pythium de Baryanum and Corticium vagum.**—*Phytopath.*, xiii, 6, pp. 273–281, 2 figs., 1923.

In this paper the results are reported of an experimental study, carried out at Wisconsin in 1922, of the relation of soil and air temperatures to the pathogenicity of *Pythium de Baryanum* and the *Rhizoctonia* stage of *Corticium vagum* var. *solani* towards

seeds and seedlings of garden cress (*Lepidium sativum*) in greenhouse cultures. The *Pythium* strain selected for the tests was isolated from sugar beet and the *Rhizoctonia* from Connecticut soil. Both strains were pathogenic to tomato and cucumber seedlings as well as to the garden cress, and the *Rhizoctonia* also injured lettuce.

In the first series of experiments only the soil temperature was controlled by means of the Wisconsin tank system, the temperature in the upper soil layers ranging from between 13° and 17° C. to between 32° and 34° C. It was found that, with both organisms, infection was not as serious at high and low as at medium temperature ranges. Neither fungus caused infection at 32° to 34°. In one case *Rhizoctonia* produced infection at 30° to 32°. At 29° to 33° both organisms failed to cause infection. At lower temperature ranges both fungi were more virulent, damping-off by *Pythium* being most severe at 22° to 27° and *Rhizoctonia* causing serious damage between 16° and 23°. Both fungi were dangerous parasites at the lowest temperature tested. The highest percentage of germination of the seedlings occurred within the temperature range 18° to 23°, retardation being perceptible over 30° C. The controls remained uniformly healthy.

The next series of experiments was conducted in thermostatically controlled chambers by means of which both soil and air temperatures were maintained at various ranges between 8° and 38° C. The results of these tests showed that the *Pythium* strain caused infection in over 80 per cent. of the seeds and seedlings at temperature ranges of about 20° to 30°. At lower temperatures the percentage of infection was progressively lower, but even at 8° to 12° there was 24·1 per cent. of injury. At the two highest ranges tested there was no germination in the control pots and very little in the infested ones, and it appears therefore that a temperature sufficiently high to prevent infection by this *Pythium* would simultaneously inhibit the germination of the cress.

The infection percentages for *Rhizoctonia* were over 80 per cent. for ranges 13° to 18°, 15° to 18°, 20° to 23°, and 22° to 26°, the fungus being most virulent at 16° to 24°. At the lowest range tested (8° to 12°) there was 72·4 per cent. of infection. The incidence of infection declined above 24°, but amounted to 53·3 per cent. at the highest range at which germination occurred in the controls (28° to 32°).

The germination percentage of the seedlings was approximately equal (68·8 to 76·3 per cent.) for all temperatures from about 10° to about 24°. Germination was retarded at higher temperatures, and inhibited at 33° to 38°.

KORDES (H.). **Biologische Untersuchungen über das in Dauerzellen und Hyphen verschiedener Pilze auftretende Fett.** [Biological investigations on the fat content of the resting cells and hyphae of various fungi.]—*Botan. Arch.*, iii, 6, pp. 282–311, 1923.

The results of a series of experiments, which are described in detail, with various Mucoraceae, Plectascineae, Saccharomycetes, Pyrenomycetes, Discomycetes, and Fungi Imperfecti showed that

the fat content of the resting cells is utilized during the process of germination and therefore constitutes a food reserve. In certain cases the fat content of the hyphae may be transferred to the resting cells and utilized in the process of metabolism, but, generally speaking, the accumulated fat in the hyphae cannot be made available for this purpose, even in starvation cultures, and must therefore be regarded as a waste product. The accumulated fat content of old fungous cells is not necessarily associated with degeneration of the protoplast but may be due to enzyme activity.

Experiments on similar lines to those of Aschoff with animals (*Path. Anat. der Zelle*, p. 335, 1919), to induce a 'fatty degeneration' of the cells of *Aspergillus glaucus*, *Pleospora herbarum*, and *Sclerotinia tuberosa* by the addition of colourless phosphorus to the culture medium gave negative results. It may, therefore, be assumed that no analogy exists in this respect between the vegetable and animal kingdoms.

By means of extraction with ether the fat content of some of the fungi used in these experiments was ascertained to be as follows: *Tubiporus rufus* 4·38 per cent. (of the total dry substance): *T. scaber* 2·96 per cent.; *Daedalea quercina* 14·62 per cent.; *Phlegmacium varium* 3·2 per cent.; *Clitocybe cyathiformis* 0·96 per cent.; *Tricholoma terreum* 5·2 per cent.; and *Hebeloma mesophaeum* 1·74 per cent. The fat constants of *D. quercina* fat approximately correspond, in certain respects, with those of myrtle wax, coco-nut oil, and Japan wax. A low iodine value is common to all. By means of micro-analysis the carbon and oxygen contents of *D. quercina* were found to approximate to those of tristearin, triolein, and tripalmetin. The chief constituent of the substance extracted with ether from *D. quercina* was resin, amounting to nearly 10 per cent. of the total dry weight. This is remarkable when it is remembered that *D. quercina* occurs exclusively on oaks and (occasionally) beech stumps, and is never found on conifers.

D[avidson] (W. D.). **Potatoes—experiments conducted in 1922, with varieties immune from black scab or wart disease.**—*Journ. Dept. Agric. & Tech. Inst. Ireland*, xxii, 4, pp. 381–385, 1923.

Although wart disease occurs only in limited areas in Ireland, the deadly nature of the disease is such that the Department of Agriculture recommends substituting immune for the susceptible kinds at present grown, as a precautionary measure against the spread of disease. In order to discover the varieties of potatoes immune from wart disease which are best suited to Irish conditions variety trials have been carried out at various centres during recent years. Those carried out in 1922 at Carlingford, Co. Louth, are described in this paper.

Yields are given of 39 varieties, of which 28 are immune. In many cases the seed was so badly infected with leaf roll as to cause a serious reduction in yield. Notes are given on some of the immune varieties, the most promising of which appear to be: *Earlies*: Edzell Blue (for home use). *Second earlies*: Great Scot, Early Maincrop, Majestic, Maincrop, Lochar, Kerr's Pink, Rhoderick

Dhu, Irish Chieftain, Arran Victory, Shamrock (for home use), Tinwald Perfection (for export).

Sandford (G. B.). **The relation of soil moisture to the development of common scab of Potato.**—*Phytopath.*, xiii, 5, pp. 231–236, 3 figs., 1923.

Extensive field observations and experimental work with common scab of potatoes (*Actinomyces scabies*) in Alberta suggested that soil moisture might frequently exert a strong influence on the development of the disease, the incidence of which is not always explicable on the basis of soil reaction or the number of organisms in the soil [see this *Review*, ii, p. 519]. Experiments were carried out at the University of Alberta in 1921 and 1922 to test this possibility under conditions approximating as closely as possible to those of the field. Plants were grown in boxes, in a dark, organic, sandy loam which had produced scabby crops previously.

In order to get a greater temperature range, one-half of the boxes used in 1921 were placed in the greenhouse, where the plants matured at high temperatures during July and August, and the rest were placed in trenches in the field. Three series were run: dry, medium, and moist, representing, on an air-dry basis, a moisture content of about 12, 18, and 28 per cent. respectively. The optimum results as regards yield were obtained from the crop grown in the soil with a medium moisture content. In 1922 five series were tried, the percentage moisture of each, on an oven-dry basis, being 8, 14, 22, 29, and 34 respectively. The best yield was again obtained from the soil with a medium moisture content (22 per cent.), although at 14 per cent. good results were also given. Both in 1921 and 1922 badly scabbed tubers were produced in the dry and in the medium soil, while the potatoes grown in the moist soil were practically clean. Scab developed exceptionally severely in the field series, where the soil temperatures ranged from 14·5° to 19° C. These figures indicate that soil temperatures in Alberta are not low enough to inhibit the development of scab.

Between 28th July and 17th September, 1922, hydrogen-ion determinations of the soils in the above experiments were made at intervals. On the first date the P_H values in the different soils were approximately equal (7·7); on 23rd August they were slightly acid (6·1 to 7·1) and on 7th and 17th September there was a return to neutrality or slight alkalinity (6·6 to 7·2). Apparently moisture, not acidity, was the controlling factor, since the dry soil, which in the later determinations was consistently the most acid, produced scabby tubers, while the more alkaline, moist soil gave nearly scab-free potatoes.

The results of a further experiment to ascertain at which stage in the development of the tuber moisture exerts the greatest influence on the development of scab showed that, if the soil is moist for a short time after the tubers are set, they will not become scabby even though the soil dries later in the season.

Lutman (B. F.). **Potato scab in new land.**—*Phytopath.*, xiii, 5, pp. 241–244, 1923.

In 1916 and again from 1919 to 1922 the author carried out

a series of field trials at the Vermont Agricultural Experiment Station with the object of ascertaining to what extent the organism producing common scab of potatoes [*Actinomyces scabies*] is present in virgin soil. In 1916 four small plots of formalin-disinfected potatoes were planted in soil which had not been cultivated for at least fifty years.

The resulting crop gave 16 per cent. badly scabbed tubers in one plot and 23 to 57 per cent. of slightly scabbed potatoes in the remaining plots. Severe *Rhizoctonia* [*solani*] infection was also found in three of the four plots. The results of similar experiments with Green Mountain potatoes in 1919 showed an average scab infection of 0·5 to 1 per cent. In 1920 part of the same land was planted with disinfected Irish Cobblers and some rows placed in a new strip, a commercial fertilizer being added. The respective percentages of scab were 7 on the land used the year before and 3 on the virgin soil.

In 1921 the Green Mountain variety was again planted in the same land. The amount of scab in the different parts of the plot varied considerably. The occasional scabbed tubers of 1919 increased to 60 per cent. of the crop at the south end of the plot in 1921, in spite of strict precautions against the introduction of the parasite, thus illustrating the rapid spread of the disease in land continuously used for potatoes.

In 1922 disinfected potatoes were again planted in virgin soil; there were 0, 6, 9, and 10 per cent. of badly scabbed and 17 to 30 per cent. of slightly infected tubers in the four plots. Twelve tubers from the 49 hills showed *Rhizoctonia* infection.

It is believed that the particular tillage methods used in potato cultivation allow the scab organisms to come to the front in the destruction of the cellulose in the soil humus, parasitism being entirely secondary.

SALMON (E. S.) & WORMALD (H.). **A new Cercospora on Humulus.**—*Journ. of Botany*, lxi, 725, pp. 134–136, 1923.

This hitherto undescribed species, named by the authors *Cercospora cantuariensis*, was observed by them in 1922 attacking leaves of the cultivated hop (*Humulus lupulus*) in a hop-garden near Canterbury, Kent. On examination it was found to differ, both in the appearance of the spots produced on the leaves and in morphological characters, from specimens of *Cercospora humuli* Hori received from Japan. The latter attacks *Humulus lupulus* and *H. japonicus*, and was described by S. Hori in his monograph of Japanese species of *Cercospora*; since this monograph is in Japanese, the authors have reproduced a diagnosis in English sent by Hori with the specimens.

Up to the present *C. cantuariensis* has been recorded only from the above-mentioned locality. It attacked living leaves, forming spots with a greyish (almost white) central portion, 1 to 5 mm. in diameter, bordered by a dark, purplish-brown line, outside which was a yellowish zone, 1 to several mm. broad, gradually merging into the normal green of the leaf; in some cases the yellow zones coalesced to form large yellow areas. Conidia were produced on

the central portion of the spots, chiefly on the lower surface of the leaves, but also occasionally on the upper; they are pale brown in colour, cylindrical, and tapering towards the round ends, variable in size, 114 to 380 by 12 to 19 μ, and with 5 to 10 septa. The conidiophores are 50 to 70 μ long, simple or occasionally furcate, non-septate, swollen at the base, and hyaline or pale brown. Latin diagnoses of *C. humuli* Hori and the new fungus are given.

SALMON (E. S.) & WORMALD (H.). **Three new diseases of the Hop.**—*Journ. Min. Agric.*, xxx, 5, pp. 430–435, 2 pl., 1923.

Of the three diseases of cultivated hops (*Humulus lupulus*) recorded in this paper as new to England, the leaf spot caused by *Cercospora cantuariensis* sp. nov. [see last abstract] has not yet been observed to cause serious injury, but it should be attentively watched as some species of *Cercospora* are known to cause heavy damage to their hosts.

Downy mildew (*Pseudoperonospora humuli* (Miyabe and Takah.) Wils.) was observed for the first time in October 1920 in the experimental hop-garden at Wye College, on seedlings raised from seed coming from Italy, forming angular spots on the leaves, the spots being dark brown above and paler on the under surface of the leaf, and bearing sporangia on the under surface. The disease failed to appear in the very dry season of 1921, but was again found in 1922 (a very wet season), both on the leaves of a considerable number of seedlings of various origin and on the hop-cones of several plants. On the latter, the bracteoles were attacked first, and this gave the hops in many cases a striped appearance, the vertical rows of dark brown bracteoles (which withered under the attack) alternating with the bracts which were still green. The causal fungus was identified by the authors with that described by Miyabe and Takahashi in 1905 as indigenous on the wild hop (*Humulus lupulus* var. *cordifolius*) and on *H. japonica* in Japan, where it causes very serious injury to the plants. It was further found in 1909 on the wild hop in Wisconsin by J. J. Davis, who believes it to be indigenous there. The manner of introduction of this disease into England is not known. On its first appearance, the affected leaves should be picked off and burned, and the whole plant should then be well sprayed with Bordeaux mixture. Any outbreak should be at once reported to the Ministry of Agriculture, as the fungus is included in the 'Destructive Insects and Pests Order' of 1922.

The third disease, for which the name 'hop-drop' is proposed, was observed in September 1922 in a hop-garden near Canterbury, on the Cobbs and Canterbury Golding varieties. The first symptom was a brown discoloration on the stalk at about half an inch below the hop-cone; later the stalks were 'eaten' through and finally a number of cones fell off before maturity. The trouble was constantly associated with the presence of a fungus (*Macrosporium* sp.) which is possibly the causal agent, although inoculation experiments have not yet been made. The fungus is probably able to attack plants only when the latter are in a state of physiological weakness, a condition thought to have resulted from the cold, wet, and windy weather prevailing during early September 1922.

Morris (H. E.) & Nutting (Grace B.). **Identification of certain species of Fusarium isolated from Potato tubers in Montana.**—*Journ. Agric. Res.*, xxiv, 4, pp. 339–363, 3 pl., 1923.

Wilt and various storage and field rots of potatoes caused by species of *Fusarium* are of considerable importance in Montana, and the investigations described below were carried out between 1914 and 1918 on cultures from nearly 100 isolations from affected tubers obtained from all sections (except the extreme north-west) of the State.

The original cultures were obtained from infected tubers by a method which is briefly described, and in 1916 a single-spore isolation was made from each. Full particulars are given of the technique adopted in the experiments. The nutrient media used were oat, Lima bean, and potato glucose agar, rice, potato tubers, and stems of sweet clover (*Melilotus alba*) and tomato. Most of the cultures were grown in the dark in an incubator between 20° and 22° C., one series, however, being kept in diffused light and incubated at room temperature (18° to 25° C.). For comparative purposes another series of cultures was grown in quadruplicate on potato glucose agar, two tubes of each culture being kept in the dark incubator at 20° C., and two others in an incubator with glass doors at 21·5° C. A further comparison was made between cultures on Lima bean agar in the dark incubator and in diffused light at room temperature.

The effects produced by the different media on cultural and microscopic characters are discussed. On the whole, oat agar proved the most satisfactory of the media used, combining good colour and development with normal spore formation. Potato glucose agar also gave good results, especially with regard to intensity of colouring. No very pronounced differences were observed between the cultures grown in the dark incubator and those grown in diffused light. Almost the only striking contrast was in culture No. 69 (*F. arthrosporioides*), which produced a carmine mycelium in the light and a white one in the dark.

No investigations were actually carried out on the effect of temperature on the cultures, but from incidental observations and the experience of other workers (which is briefly summarized), growth would appear to be equally good at room temperature, within a range of 12° to 25° C., and at a fixed temperature. Cultures kept in a refrigerator at 10° C. after about a week's growth at room temperature, showed an unusually good spore condition, while those placed in the light incubator at 30° to 35° C. rapidly deteriorated.

No definite conclusions could be drawn as to the effect of age on spore formation, since such factors as humidity, nutrients, and temperature enter into and complicate the work of analysis.

The cultural and microscopic data acquired from the above investigations were carefully studied and many of the cultures identified with the aid of Sherbakoff's key (*N. Y.* [*Cornell*] *Agric. Exper. Stat. Mem.*, 6, p. 97, 1915). The majority fell into Wollenweber's three sections, *Elegans*, *Discolor*, and *Martiella*. The section *Elegans* included 10 isolations of *F. oxysporum* var. *asclerotium* and one of *F. sclerotioides* var. *brevius*. The species contained

within the section *Discolor* were 22 cultures of *F. tricothecioides*, 1 of *F. culmorum*, 4 of *F. subpallidum* var. *roseum*, 4 of *F. clavatum*, and 2 of *F. discolor* var. *sulphureum*. The authors doubt whether the three last-named species are really distinct. The section *Martiella* included 14 isolations of *F. solani* and one of *F. coeruleum*. Detailed descriptions of all the above-mentioned species of these three sections are given. Of the few cultures which fell outside these main sections, *F. gibbosum* was referred to the section *Gibbosum*, *F. subulatum* var. *brevius* to *Roseum*, *F. arthrosporioides* and *F. anguioides* (doubtful) to *Arthrosporiella*, and *F. bullatum* to *Ferruginosum*.

The authors discuss some of the difficulties connected with the identification of species of *Fusarium*, suggestions being made for a standardization of cultural methods, and the need for a good monograph of the genus emphasized. The practice of unduly complicating the work of identification by trinomial nomenclature is deprecated.

BERNARD (C.). **Verslag van het Algemeen Proefstation voor Thee over het jaar 1922.** [Report of the General Experiment Station for Tea for the year 1922.]—*Meded. Proefstat. voor Thee*, lxxxiii, 27 pp., 1923.

This report contains (p. 9) the following reference to root diseases of tea. *Armillaria* [*mellea*] occurs extensively in Java and Sumatra in young plantations on fertile forest soil, but as a rule the disease disappears of its own accord after six to eight years. *Rosellinia* [*arcuata* and *bunodes*], *Fomes* [*lignosus*], and especially *Poria* [*hypolateritia*] cause considerably greater damage on older plantations, appearing suddenly and gradually spreading over wide areas. The author observed one case in which the infected gardens had been neglected, with the result that 50 per cent. of the area was rendered valueless. Diseased patches should be isolated from the rest of the plantation by means of deep, circular trenches, dug up, and treated with lime. A considerable time should elapse before replanting such areas.

Regulations against Banana diseases in Jamaica.

Revised regulations under the Protection from Disease Plants Law in Jamaica have recently been issued prohibiting the removal of any banana or plantain suckers from the parishes [which are named] declared to be infected with Panama disease [*Fusarium cubense*] and banana borer, except under a permit from the Director of Agriculture.

IMPERIAL BUREAU OF MYCOLOGY

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DRECHSLER (C.). **Some graminicolous species of Helminthosporium. I.**—*Journ. Agric. Res.*, xxiv, 8, pp. 641–739, 33 pl., 1923.

This important work describes in detail the morphology of twenty-five species of *Helminthosporium* occurring on graminaceous hosts, and of these eleven are new. It has been sought particularly to present the distinctive features of the fungi as they occur on the host plants, and to describe the typical lesions they cause. These lesions are first discussed. Spot blotch (*H. sativum* on barley and wheat) is a well-defined, more or less longitudinal blotch, ranging in colour from light brown to nearly black; foot rot occurs when the leaf sheaths are involved and the base of the stem becomes uniformly discoloured. Eye spot is a spot blotch, in which the centre has paled. In net blotch (*H. teres* on barley) the leaves show an irregular, brown discoloration, within which may be recognized a network of darker longitudinal and transverse linear streaks. In stripe (*H. gramineum* on barley) yellow longitudinal lines appear, along which the leaf may split after death. In white blast (*H. turcicum* on maize) decolorized areas are formed which may become surrounded by a darker margin; in small leaves proportionately large segments may be involved, and with withering starting at the tip, a wilt may be simulated.

For specific diagnosis of the fungi, the conidia give the best characters. The width is usually of more value than the length. Colour may also help; it varies from sub-hyaline, through yellow and brown, to olivaceous. The conidia often have some peculiarity of shape by which they may be recognized with fair certainty; e.g. the straight, cylindrical contour of *H. avenae* and the curved, ellipsoidal shape of *H. sativum*. In *H. teres* the proximal cell is hemispherical, in *H. bromi* hemi-ellipsoidal, and in *H. tritici-repentis* elongate-conical with a rounded apex. In *H. turcicum* the basal half of the conidium abruptly tapers to the hilum. In the

maturation of the conidium, each segment may form a segment membrane, the whole being enclosed in the old conidial wall. Drawings of conidia with abnormally swollen walls and coarsely granular contents should be received with caution, as they are likely to have been taken from dead specimens. In cultures, forms most closely resembling the normal on the host are obtained on media containing little nutriment. Of the species described, only those on certain cereals are noted below.

H. gramineum Rabh. (*Napicladium hordei* Rostr.), causing stripe of barley, was founded in 1884, but was not clearly differentiated from *H. teres* until a paper by Ravn appeared in 1898. The life-history of this fungus is different from that of the other cereal specimens of the genus. Conidia in contact with the seed immediately infect the seedling tissues; after this, the parasite grows with the host, maintaining itself near the growing point, so that the whole of the host tissue is infected. This fungus is now known to cause one of the most widespread diseases of barley, and is reported with certainty from most northern European countries, North America, Argentine, China, Japan, and India. A number of records from these countries, however, should be referred to *H. sativum*.

H. teres Sacc. (*H. hordei* Eidam), which is the conidial stage of *Pyrenophora teres* Died., causes local foliar lesions called net blotch or helminthosporiosis of barley. By the older writers it was not differentiated from *H. gramineum*, and more recently Bakke, followed by Butler, has referred *H. sativum* to this species. The most characteristic symptom of the lesion is the distribution of the brown pigment into very narrow lines, placed both longitudinally and transversely to the axis of the leaf. The seedling is infected during germination, giving rise to primary lesions on the first leaf; from these the disease is spread by the conidia to the succeeding foliage, and thence again to the inflorescence, where the seed becomes inoculated. The main diagnostic features of the conidia are the hemispherical shape of the basal cells with the hilum located internally, and the subcylindrical contour with slightly irregular crooks. The disease is widely spread in America.

H. avenae Eidam (*H. avenae-sativae* (Br. & Cav.) Lindau) causes leaf spot of oats. It has been referred to *H. gramineum* by Ritzema Bos, Frank, and Fraser. The morphology of the conidia and the life-history of the parasite resemble those of *H. teres*, but the symptoms of the host are quite distinct, consisting in the development of one to four brown spots on each leaf.

H. sativum Pammel, King, & Bakke (*H. acrothecioides* Lindfors, and probably the earlier described *H. sorokinianum* Sacc.) causes the serious late blight of barley and various types of wheat disease. It has been referred to *H. gramineum* by E. C. Johnson in the United States, Massee in England, Palm in Java, and Bassi in Italy, to *H. inconspicuum* by Peck and Atkinson, and to *H. teres* by Bakke. It is also certainly or probably, in different cases, the *Helminthosporium* sp. of Beckwith, Bolley, Evans, Hungerford, McKinney, L. J. Stakman, and F. L. Stevens in the United States, Waterhouse in England, and Hamblin in Australia. The species identified from wheat in Uganda as *H. sorokinianum* is probably

the same. It is reported on barley from 24 states of America, from Canada, and is probably frequent in Europe. It is by far the most usual cause of black point of barley and wheat seed, and the following diseases of wheat are referred to it by the author: stunting of growth, seedling blight, basal browning, root rot, foot rot, node decay, leaf spot, and stem decay. It is also known as a parasite on rye and many pasture grasses, and probably as a saprophyte on maize.

H. turcicum Passer. (*H. inconspicuum* Cke & Ellis) causes leaf blight or white blast of maize. It often only attacks the lower leaves when these are dying, but in certain seasons it functions as a dangerous parasite. What may be another species is reported by Reinking from the Philippines on the tassels of maize, but the author has only had the opportunity of examining this fungus in dead material. *H. turcicum* has been reported in sorghum in various countries but the author has not compared the form on this host with that on maize.

H. oryzae B. de H. (*H. macrocarpum* Thuem. not Greville, *H. oryzae* Miy. & Hori) has been reported on rice from various parts of Asia and from Uganda. It is also present in Louisiana and Texas. It has been fully described recently by Nisikado and Miyake [see this *Review*, ii, p. 230].

On *Eleusine indica* two species are described, *H. giganteum* Heald & Wolf and *H. leucostylum* n. sp.

Each species is fully illustrated, and a bibliography of 164 titles is appended.

BEETS (A. N. J.). **Bemestingsproeven 1918–1919.** [Fertilization tests 1918–1919.]—*Meded. Proefstat. voor Vorstenlandsche Tabak*, xlvi, 66 pp., 1923. [English summary.]

In the course of fertilizer trials on tobacco in the Vorstenland district of Java it was observed that 'dessa' earth [which is the most frequently used manure for tobacco in this district, and is a compost of refuse, leaves, ash, &c., from the native villages or 'dessas'], and also stable manure, favourably influenced the yield, length of leaf, and quality of the product but contributed to infection by *Phytophthora nicotianae*, the cause of the 'lanas' disease [see this *Review*, i, p. 20, and ii, p. 36]. There appears to be no doubt that the fungus does not live over in the soil but is transmitted by 'dessa' and stable manure.

D'ANGREMOND (A.). **Phytopathologische onderzoekingen.** [Phytopathological investigations.]—*Meded. Proefstat. voor Vorstenlandsche Tabak*, xlvii (*Jaarverslag 1 Mei 1921–30 April 1922*), pp. 10–14, 1922.

It has been already shown [see this *Review*, ii, p. 36, and last abstract] that the use of stable manure and 'dessa' earth on tobacco seed-beds contributed in a high degree to infection by *Phytophthora* [*nicotianae*], the cause of the 'lanas' disease. The author considers that this is the most important factor in the control of the disease and discusses the organization of a series of field experiments to test the possibility of substituting artificial fertilizers for organic manure.

Slime disease [*Bacillus solanacearum*] was prevalent, and was obviously due, in many cases, to the growing of the susceptible 'Katjang tanah' [*Arachis hypogaea*] immediately before the tobacco crop.

JOHNSON (J.). **A bacterial leafspot of Tobacco.**—*Journ. Agric. Res.*, xxiii, 6, pp. 481–492, 4 pl., 1923.

A bacterial leaf spot disease of tobacco has been under investigation in Wisconsin during the last five years. It forms one of a group of different leaf spots commonly known as 'rust', the other members of which appear to be non-parasitic in nature. The disease has not been specially serious of recent years, but it is believed to be identical with the 'rust' which caused considerable damage in the past, and may do so again under suitable conditions.

The Wisconsin leaf spot of tobacco differs from wildfire (*Bacterium tabacum*) and angular leaf spot (*Bact. angulatum*) occurring in other sections of the United States, and from the black rust (*Bact. pseudozoogloeae*) prevalent in Sumatra. The symptoms of the wildfire disease [see this *Review*, ii, p. 37] and of the Wisconsin leaf spot are, however, very similar.

Round, brown or rust-coloured spots, usually less than half an inch in diameter but frequently merging into larger, irregular lesions, appear principally on the lower leaves of field plants and on young leaves in the seed beds. The young lesions are often marked by a distinct chlorotic area or halo surrounding the point of infection. An interesting symptom frequently following artificial infection is the formation of a secondary ring of small lesions, 2 or 3 mm. beyond the circumference of the primary lesion. This appears to be the result of renewed activity on the part of the parasite after a temporary check.

The cause of the disease is a yellow bacterium, apparently not hitherto described, for which the name *Bact. melleum* n. sp. is proposed, the group number being 221.3333633. The bacterium is a short rod with rounded ends, occurring singly, in pairs, or in chains; 0·6 to 1·8 μ, motile by a tuft of 1 to 7 (usually 2 or 3) polar flagella three to five times as long as the body of the organism; capsules present, Gram negative, non-acid-fast. The organism is pale or orange-yellow on most media, especially potato dextrose agar, on which slant growth is abundant, echinulate, raised, glistening, smooth, and viscid, and the colonies circular, smooth, and convex. On nutrient broth the surface growth is slight or absent. Milk is promptly coagulated and there is an alkaline reaction with litmus milk. Growth in Fermi's and Cohn's solutions is good, indol and ammonia are not produced, and there is no reduction of nitrate in nitrate broth. The optimum temperature for growth is 26° to 28° C., maximum 35° to 36° C., thermal death point 57°, optimum reaction for growth in broth +10 Fuller's scale. It differs from both the wildfire and angular leaf spot organisms in being orange-yellow instead of white, and from *Bacterium pseudozoogloeae* by various characters which are mentioned.

The organism is readily isolated from young lesions, and artificial infection was always secured on leaves wounded by needle pricks. Wounding is not, however, believed to be a pre-requisite condition

for field infection, and this belief is strengthened by the fact that the wildfire organism, with which comparative tests were made, gave similar results under the same greenhouse conditions. Temperature and humidity relations are apparently not the only or even the most decisive factors in the causation of the disease. Field plots at Wisconsin, to which 20 tons of farmyard manure per acre were added, had 44·5 per cent. plants infected whilst the controls gave only 24·5, and this result indicates that infection is correlated with the application of farmyard manure.

The use of plants from infected seed-beds, where the disease probably originates, should be avoided.

Bondartzeva-Monteverde (V. N.). Новая пятнистость плодов Томата: **Diplodina lycopersicola V. Bond.-Mont. sp. nov.** [A new spotting of Tomato fruits: *Diplodina lycopersicola* V. Bond.-Mont. sp. nov.]—'*Plant diseases*', *Journ. Centr. Phytopath. Stat. Chief Bot. Gard. Russian Republic*, xi, pp. 24–31, 5 figs., 1922.

This disease was found by the author in the period from 1915 to 1922, first in the governments of Koursk and Orloff and later in that of Petrograd, attacking indifferently quite green, half ripe, and wholly ripe tomato fruits. The chief external symptom is the development of a large black spot, usually on the top but sometimes on the side of the fruit. The spot is somewhat depressed, warty and almost black in the centre, while it is brown and surrounded by convex zones of a light brown to a dirty green colour at the margin. Sometimes it is in places covered with spores, which form a flesh-coloured, slimy layer. A brief morphological description of the fungus and its fructifications, together with a Latin diagnosis, is given. The pycnidia are numerous, aggregated towards the centre, sparse at the margin, and 120 to 200 μ in diameter. The conidia are uniseptate and 8 to 10 by 3 μ, or sometimes 5 to 9 by 2 to 3 μ, cylindrical or less often elliptical or slightly curved, rounded at both ends, sometimes slightly constricted in the middle, and with 2 or 3 oil drops.

The fungus was isolated in pure culture and the growth on various media is described. Successful inoculations were obtained on wounded leaves, causing the development of brown spots and finally killing the leaf. The fungus does not appear to be capable of penetrating the uninjured cuticle of the fruit.

As regards its relation to allied species described as attacking the tomato, the author notes that the external symptoms are very similar to those described by Plowright and by Miss Jamieson as resulting from *Phoma destructiva*, but the spores of the latter are stated to be continuous and to vary in size from 2·8 to 8·5 μ long and 1·7 to 3·4 μ broad. From *Phoma lycopersici* (Plowr.) Jacz. (*Sphaeronema lycopersici* Plowr.) it also differs, since the latter has pycnidia 150 μ in diameter, arranged concentrically, and conidia similar in size to those of *P. destructiva*. *Diplodina lycopersici* Hollós has larger pycnidia, 200 to 250 μ in diameter, and yellowish conidia, 10 to 15 by 3 to 4 μ. *Ascochyta lycopersici* Brun. is stated to be evidently, from the description, very similar to the author's fungus, having conidia 8 to 10 by 2·5 μ in diameter; and the same

may be said for *A. socia* Passer., in which the spores are a little broader and somewhat constricted in the middle. These two fungi, however, must differ in the structure of the pycnidium from the author's fungus, since hers is a true *Diplodina* as defined by Diedicke and not an *Ascochyta*. [The author does not appear to have seen the papers by Petrak and by Brooks and Searle (see this *Review*, i, pp. 149, 150) in which the relationship of the fungi mentioned above is fully discussed, and it is shown that most of them are probably different phases of the same fungus.]

WEIR (J. R.). **Polyporus spraguei Berk., cause of heart rot.**—*Phytopath.*, xiii, 6, p. 288, 1923.

This fungus is reported as the cause of a brown, friable rot in the heart wood of the trunk and roots of five species of *Quercus* and of *Castanea dentata*. The fungus fruits abundantly after the trees are cut down.

MÖBIUS (M.). **Das Absterben der Edelkastanien im Taunus.** [The dying off of the Chestnut trees in the Taunus.]—*Ber. Senckenbergischer naturforsch. Gesellsch.* [Frankfurt-am-Main], lii, 1, p. 28, 1922. [Received 1923.]

No insect or fungous parasite has yet been found to explain the gradual dying out of the chestnuts in the forests of the Taunus mountains [Germany]. The phenomenon is very generally attributed to the droughts which occurred in 1911 and various subsequent years, although some authorities favour the view that excessively deep planting is responsible for the trouble. The trees show signs of wilting, cease to form new growth, and generally die in the second or third year after a year of drought.

GRINTESCU (J.). **Sur l'oidium du Chêne et ses périthèces.** [The *Oidium* of the Oak and its perithecia.]—*Bul. Soc. Stiinte Cluj*, i, 3, pp. 497–505, 4 figs., 1923.

At the end of August 1922 the writer found numerous perithecia of *Microsphaera quercina* [see this *Review*, i, pp. 97, 335] on *Quercus pedunculata* in Transylvania. The leaves of the annual shoots, deformed by the action of the parasite, were covered by a luxuriant mycelium and bore groups of perithecia, in different stages of development, measuring 130 to 150 μ. Each perithecium bore ten to twenty appendages, slightly rugose at the base, almost as long as the diameter of the perithecia, and terminating in dichotomous, cylindrical ramifications. The interior of the perithecia contained as many as ten pyriform asci, each enclosing four to eight ascospores. The few conidia observed after the autumn rains were ellipsoid and borne at the tip of pluricellular conidiophores. During the earlier part of the year, however, they were produced in such abundance that showers of white dust fell from the branches.

The varieties of oak most severely attacked in Roumania are *Q. pedunculata* and *Q. sessiflora*. The mild winter, damp spring, and dry summer of 1922 appear to have been particularly favourable to the development of the disease, which is stated to cause incalculable damage to the oak forests of Roumania.

Cook (M. T.). **Blister rust of the White Pine.**—*Phytopath.*, xiii, 6, p. 283, 1923.

In 1921 an infected block of black currants in Camden county, New Jersey, was selected for a field test on the problem of the over-wintering of *Cronartium ribicola*. The nearest known alternate hosts were at least $\frac{3}{4}$ mile distant and were not infected. The currants were growing in a young apple orchard bounded on two opposite sides by narrow strips of forest.

In March 1922 a double-thickness cheesecloth tent was erected over a considerable number of the plants, which were inspected in the following May, June, and August. At the first inspection a single infected leaf was found some distance from the tent, at the second there was a considerable amount of infection in the plantation, and at the third the plants under the tent were very generally infected, though less so than in the previous year. Although it is possible that spores may have penetrated the tent, the evidence is thought to indicate that the fungus can be carried from year to year on the currants.

Baxter (D. V.). **White Pine blister rust in Michigan.**—*Phytopath.*, xiii, 6, pp. 285–286, 1923.

During the past season four different infections of pine with *Cronartium ribicola* were located in Michigan, one of which also involved *Ribes americanum*, *R. aureum*, *R. cynosbati*, *R. nigrum*, and *R. vulgare*.

The first outbreak of this rust on pine in Michigan was found in 1917, a year after the first report of the disease in Wisconsin, and other cases were noted in 1919 but none in 1920 or 1921. Until the present year all efforts to locate the disease on currants and gooseberries failed. Up to date all infections can be traced to white pine of French origin, apparently imported before the establishment of quarantine regulations.

Detmers (Freda). **Dothichiza canker on Norway Poplar.**—*Phytopath.*, xiii, 5, pp. 245–247, 1923.

In 1917 a plantation of Norway poplars (*Populus eugenei*) in Paint Creek, Ohio, became infected by a bark disease which was identified, in 1921, as being due to *Dothichiza populea* Sacc. & Bri. The fungus has previously been reported to occur in the United States and Canada on *P. nigra* and *P. deltoidea* [see this *Review*, ii, p. 96], but this is believed to be the first record of its appearance on *P. eugenei*. In 1921 the disease became so destructive that the cultivation of the Norway poplar was abandoned, except in a six-year-old block of trees where the attack was less severe.

Infection occurs at the nodes, the discoloured area being situated below the leaf scar, in the bud axil, or on either side of the bud. As a rule the infection does not extend beyond one-year-old wood, but in severe cases the current year's growth may also be invaded. The trend of infection appears to be upward from the lower to the higher nodes. Numerous pycnidia, from which broad, short spore-threads emerge, are scattered over the infected areas. Cankers on older branches are rough, and in severe attacks the bark becomes deeply fissured. The sap wood is invaded, and lateral

branches from infected areas are killed. The cankers spread laterally, finally coalescing and girdling the trunk. The upper buds remain healthy and continue to show the vigorous and rapid growth characteristic of the Norway poplar, a brief account of the history and habits of which is given.

CUTLER (N. L.). **A contribution to the knowledge of the tree destroying fungi of the Vancouver forestry district.**—Abs. in *Phytopath.*, xiii, 6, p. 294, 1923.

The following 24 species of fungi were found to be associated with the destruction of trees in the Vancouver region:—*Fuscoporia ferruginosa*; *Fomitoporia tsugina*; *Poria* sp., *P. subacida*; *Fomitoporella betulina*; *Coriolus versicolor, C. delectans, C. balsameus*, and *C. abietinus*; *Piptoporus suberosus*; *Polyporus fissus*; *Laetiporus speciosus*; *Phaeolus sistotremoides*; *Fomes roseus, F. ungulatus*, and *F. laricis*; *Pyropolyporus robiniae*; *Porodaedalea pini*; *Elfingia megaloma*; *Ganoderma oregonense, G. sessile*; *Daedalea confragosa*; *Gloeophyllum trabeum* and *G. abietellinum.* Murrill's nomenclature appears to have been followed in the determination of the species. *Tsuga heterophylla* and *Pseudotsuga taxifolia* were attacked by the largest number of species.

VANIN (S. T.). Вредители древесных пород в различных насаждениях Романовского лесничества Тамбовской губ. в 1918 г. [Pests of forest trees in the different plantations of the Romanoff Forestry Area of the government of Tamboff in 1918.]—'*Plant diseases*', *Journ. Centr. Phytopath. Stat. Chief Bot. Gard. Russian Republic*, xi, pp. 9–23, 1922.

This publication gives a comprehensive list of the insect and fungous pests attacking forest trees in the Romanoff Forest Area in the Tamboff government, giving some ecological notes on the forest sections in which the collections were made. The following fungi were found to be the most dangerous, calling for serious control measures:—*Caeoma pinitorqua* on pines [*Pinus*]; *Fomes fomentarius* on birch [*Betula*]; *F. igniarius* on birch, aspen [*Populus*], oak [*Quercus*]; *Polyporus betulinus* on birch; *P. caudicinus* and *Vuilleminia comedens* on oak. Pure plantations of birch trees were found to be more heavily infected (15 per cent.) with *Fomes fomentarius* and *Polyporus betulinus* than mixed plantations (10 per cent.).

HUNGERFORD (C. W.). **A Fusarium wilt of Spinach.**—*Phytopath.*, xiii, 5, pp. 205–209, 4 figs., 1923.

During the summer of 1919 a hitherto unreported disease of spinach was observed in various localities of Idaho [see this *Review*, ii, p. 100]. A few of the seedlings were markedly lighter in colour than the rest, with the margins of their outer leaves rolled inwards, and in about ten days these plants died. At the end of three or four weeks nearly all the plants in the affected gardens had succumbed to the disease.

The root system of the affected plants was found to be practically destroyed, and upon splitting the crown and main root a pronounced vascular browning, such as is characteristic of certain wilt

diseases, was observed. A species of *Fusarium* was readily isolated from the diseased roots; this was considered to be a new species by Sherbakoff, who named it *F. spinaciae*, a full English diagnosis being given in the present paper.

Spinach seed of the Long Standing variety planted in soil inoculated with a pure culture of this *Fusarium* from diseased roots produced plants with the typical symptoms of the wilt, while the controls grown in uninoculated, sterilized soil, remained healthy.

In the garden where the disease was first noted, spinach had been planted in the same place for two consecutive years, and self-sown plants were found in large numbers before the ground was ploughed in the spring of 1919. It is reasonable to assume that the very severe infection in this particular garden was due to the overwintering of the fungus either in the self-sown plants or in the soil.

Cook (M. T.). **Dwarf Asparagus.**—*Phytopath.*, xiii, 6, p. 284, 1923.

A disease of asparagus which causes dwarfing or stunting of the plants has occurred in New Jersey for several years past. The plants are usually thick, short, and somewhat irregular in shape, the underground portions of the stem showing a slight cracking and a more or less pronounced brown discoloration, resembling that caused by *Rhizoctonia* [*solani*] on potatoes. A species of *Fusarium* was always found associated with the disease.

In 1921 severe cases were observed in two fields. The affected plants were stunted and gradually died, but new shoots were sent up and usually became heavily infected with the *Fusarium*. During the winter of 1921–22 a number of healthy greenhouse plants were inoculated with this fungus at intervals, the results showing that:—(1) the organism is a pathogen producing the above-mentioned symptoms; (2) young shoots are more easily infected than older ones; (3) stems penetrating above the soil without becoming infected are not likely to contract the disease; (4) slight injuries to the stem promote infection; (5) very young stems may be infected without previous wounding; (6) stems four or more inches in height are not liable to infection even when injured. The organism was recovered from all the infected plants. Its identity is not specified.

Welles (C. G.). **Leaf spot of Lettuce.**—*Phytopath.*, xiii, 6, p. 289, 1923.

An apparently undescribed *Cercospora* leaf spot of lettuce was observed from March to May 1922 at the Los Baños (Philippine Islands) College of Agriculture.

The lesions appeared as small, watery spots at the leaf edges, gradually spreading inwards and producing a brown discoloration of the older tissues, on which conidiophores and conidia were found. The former measured 63·2 to 130·3 by 6·3 to 7·5 μ and had 5 to 8 septa, and the latter 43·4 to 96·3 by 4·7 to 5·6 μ and had 5 to 12 septa. The brownish conidiophores, produced in bunches, were simple, erect, and frequently geniculate. The conidia were straight or slightly curved, hyaline, tapering, and linear. The name

Cercospora lactucae n. sp. is proposed for the fungus. Though not fatal to the plant, in severe cases every leaf may be spotted and many may be killed.

STONE (R. E.). **Root rot and blight of canning Peas.**—Abs. in *Phytopath.*, xiii, 6, p. 293, 1923.

A serious root rot and blight of canning peas occurred during the summer of 1922 in certain parts of Canada. Seed treatment and the application of fertilizers were found to be useless, but it is believed that the disease may be combated to some extent by a long period of rotation, thorough drainage, and the use of resistant strains.

A species of *Fusarium* was isolated from the diseased plants, but other fungi are believed to be probably also associated with the trouble.

WALKER (J. C.). **The hot water treatment of Cabbage seed.**—*Phytopath.*, xiii, 5, pp. 251–253, 1923.

The investigation outlined in a previous paper [see this *Review*, ii, p. 104] has recently been continued in order to determine the most satisfactory method of disinfecting cabbage seed against the blackleg organism (*Phoma lingam*). It was found that complete disinfection could be secured by 30 minutes' immersion in water heated to a temperature of 50° C. The process was not accelerated by increasing the temperature to 55° C. Immersion for 15 minutes at 50° C. was not sufficient for complete disinfection, and the mercuric chloride treatment also proved unsatisfactory. The hot water treatment resulted in a moderate reduction of germination in seed under six months old, the injurious effects increasing with the age of the seed at the time of immersion. In view of this serious drawback the hot water treatment cannot be recommended for general use, but it may safely be adopted in special cases where the age of the seed is definitely known.

ARRHENIUS (O.). **Försök till bekämpande av Betrotbrand.** [Experiments in the control of Beetroot rot.]—*Meddel. Centralanst. för försöksväsendet på jordbruksområdet*, 240, 12 pp., 1 col. diag., 1923.

Root rot of sugar beets, with which are associated the three fungi *Pythium de Baryanum*, *Aphanomyces levis*, and *Phoma betae*, has caused considerable damage in Sweden during the last few years. Henning investigated seriously affected areas (Skåne and Halland) in 1919 and found that the time of sowing appeared to exercise some influence on the incidence of the disease, late-sown crops being most heavily infected. Analyses of samples of soil from the infected fields showed an acid reaction in every case.

One of the causal organisms, *Phoma betae*, being transmitted by the seed, many experiments have been carried out to determine the efficacy of fungicides in the control of the disease. Very good control was secured as early as 1890 by steeping the seed in carbolic acid, but most of the later experiments [bibliographical references to which are given] led to conflicting results.

On the other hand, the work of previous investigators has shown

that fertilizers which promote vigorous development of the plants control the disease. Phosphate and potash salts are particularly efficacious, Chile saltpetre giving contradictory results, and ammonium salts being definitely harmful. The liberal application of lime appears to have given the best results of all, especially in conjunction with thorough cultivation of the soil.

In 1922 comparative tests were carried out in healthy and infected soils, most of the former being slightly alkaline and the latter slightly acid. The most favourable reaction for the development of the beets and the control of the disease appeared to be P_H 7·2 to 7·6 (probably near 7·5), which may be secured by the application of lime in suitable quantities (cf. Arrhenius, Bodenreaktion und Pflanzenwachstum, Leipzig, 1922). The application to the soil of various combinations of mineral salts and organic manure increased the yield of the crop but did not prevent the disease. In another series of tests the application of gypsum increased the yield of the crop but failed to suppress the disease, whereas sodium hydroxide (to P_H 7·4) acted similarly to lime as a means of control.

The results of cultural experiments with *Pythium de Baryanum*, the most frequent cause of root rot, showed that the growth of the fungus is almost entirely inhibited at P_H 7·5, which would explain the absence of the disease on slightly alkaline soils.

A map showing the soil reactions in one of the affected localities is appended.

PUTTERILL (V. A.). **Plant diseases of the Western Cape Province. VIII. Court-noué or short node disease of the Vine.**—*Journ. Dept. Agric. S. Africa*, vi, 5, pp. 458–460, 2 figs., 1923.

Court-noué (' short node ') disease of the vine, or ' tandpynziekte ', as it is called in South Africa, was observed by the author for the first time at Paarl in September 1922. Its very characteristic feature—shortening of the internodes owing to the poor development of the young shoots—makes its recognition easy. The difference between dwarfed and healthy shoots is considerable, the former being only from 3 to 6 cm. long, while the latter attain as much as 50 cm. The leaves remain small and crumpled, and the growth of the vine appears to have been arrested. Later in the season growth is resumed, but the vines remain backward owing to the early set-back. The grapes produced either come to nothing, or else the clusters are small and slow in ripening. Though the disease is not infrequent in South African vineyards, generally only one or two vines are affected.

This disease is said to be a serious one in France and to be widely spread in the northern hemisphere. In France court-noué is held to be correlated with various soil conditions, while a disease having similar symptoms in Switzerland has been shown to be caused by a parasitic mite (*Phyllocoptes vitis*). In South Africa no evidence was obtainable that insects or mites had anything to do with the malady. The interesting fact is recorded that in one instance a cure was effected at Paarl by spraying the vines in winter with lime-sulphur. Affected vines have also been improved considerably by spraying with iron sulphate at the rate of ½ to 1 lb. of sulphate per vine.

The disease may be due to some specific cause and not to general soil conditions, and it is hoped that opportunities will be afforded of investigating it in South Africa more fully.

Department of Botany.—*Rept. Director Purdue Agric. Exper. Stat., Lafayette, Indiana, for the year ending June 30, 1922*, pp. 19–23, 3 figs., 1922. [Received, 1923.]

During the period under review progress was made in the attempts to isolate strains of maize possessing different degrees of susceptibility to the organisms associated with the rotting of the roots and stalks.

It was found that the influence of certain soils increased the liability to root rot of some strains of maize more than others. The chief effects upon the plants studied up to date are those associated with accumulations of iron and aluminium compounds within the plants themselves [see this *Review*, iii, pp. 32, 33].

Inoculation experiments with *Gibberella saubinetii* were carried out on the sweet corn and Dent varieties of maize, several rows of the former showing slight infection while the latter remained healthy. The tests were conducted on slightly acid soil.

Leaf rust of wheat [*Puccinia triticina*] assumed epidemic proportions in southern Indiana during 1921–22, numerous fields being entirely destroyed. The average loss in the south from the disease is estimated at 20 per cent. and in other parts of the State at 10 per cent. Considerable progress was made in the work of securing resistant varieties, strains of Malakoff, Kanred, Fulcaster, Beloglina, Turkey, Michikoff, and Michigan Amber showing promise of adaptability to Indiana conditions. Further study of the biology of the fungus has shown that the aecidial stage, under favourable conditions, may be produced in the field when susceptible species of the alternative host [*Thalictrum*; see this *Review*, i, p. 166] are exposed to infection.

Investigations conducted on the leaf rust of rye (*Puccinia dispersa*) resulted in the discovery of highly resistant or immune individuals.

The complete life-cycle of the leaf rust of barley [*Puccinia simplex*] has been demonstrated under field and greenhouse conditions, showing that the fungus has its aecidial stage on Star-of-Bethlehem [*Ornithogalum umbellatum*]. This agrees with the results obtained in Russia [Tranzschel, *Mycol. Centralbl.*, iv, p. 70, 1914]. In southern Indiana and elsewhere the Star-of-Bethlehem has altogether run wild, and its escape from cultivation may be of considerable importance in spreading the disease.

Ample evidence was obtained of the hibernation of the tomato mosaic virus in the related perennial weeds, horse nettle [*Solanum carolinense*] and certain ground cherries [*Physalis*: see this *Review*, ii, p. 474], and preliminary tests indicate that much of the tomato infection can be avoided by the eradication of these weeds.

Apple blotch [*Phyllosticta solitaria*] occurs in nurseries and may be introduced into the orchards in canker form on susceptible nursery stock. It was found that 95 per cent. of the cankers on bearing wood of Northwestern Greenings occur at leaf scars as the result of petiole infection and subsequent invasion of the twig from

the growth of the fungus down through the petiole. Some cankers originate from bud-scale infection of short spurs, and growth of the fungus from the base of the spur into the bark of the larger limbs.

So-called 'take-all' or 'rosette' of wheat [see below, p. 84] has been shown to persist in the soil for over three years, but the existence of numerous varieties immune from the disease considerably facilitates its control.

Important diseases not hitherto reported from Indiana included a *Phytophthora* rot of apples, mosaic of celery and clover, powdery mildew of clover [*Erysiphe polygoni*], a *Phytophthora* fruit rot of eggplants, parsnip leaf spot [*Cercosporella pastinacae*]; pea bacterial spot, downy mildew of spinach [*Peronospora effusa*], angular leaf spot of tobacco [*Bact. angulatum*], tomato collar rot, and true 'take-all' of wheat [*Ophiobolus cariceti*].

GUERRERO (J.). **Report of the Assistant in Agronomy and Horticulture.**—*Rept. Guam Agric. Exper. Stat., 1921,* pp. 8–26, 1923.

At the Tarague coco-nut plantation, jack beans under trial as a cover crop were attacked by a disease resembling mosaic.

In varietal tests of tobacco the seedlings were found to be very susceptible to damping-off in the seed-bed, which was, however, shown to be controllable by sterilizing the seed-bed by steam. The plants in a treated plot in the plant-house made vigorous growth and were practically free from disease, while those in untreated soil suffered severely from damping-off and were generally weak. Sterilized soil did not hold moisture so well as unsterilized.

PEARL (R. T.). **Report of the Mycologist to the Government of the Central Provinces and Berar.**—*Rept. Dept. Agric., Central Provinces and Berar, for the year ending 30th June 1922,* pp. 19–20, 1923.

A preliminary survey of the region indicates that the following are the major crop diseases of the Central Provinces and Berar, India. Jowar [sorghum] is very seriously attacked throughout the district by grain smut (*Sphacelotheca sorghi*), and in a lesser degree by loose smut (*S. cruenta*). Head smut (*Sorosporium reilianum*) is observed occasionally. Almost the entire loss from these diseases is readily preventable, and a scheme for a propaganda for encouraging seed treatment with copper sulphate has been developed. *Cladosporium herbarum* has frequently been noticed attacking the leaf, stem, or ear, especially in connexion with severe damage by the sorghum stem borer and with a stem wet rot.

Fusarium wilt of cotton causes serious damage in many of the cotton-growing tracts of Berar and elsewhere; the disease is believed to be spreading. *Rhizoctonia* root rot has also been reported in this crop.

Loose smut of wheat (*Ustilago tritici*) occurs regularly, causing considerable local losses in certain seasons. During the period under review rust caused by *Puccinia graminis*, *P. glumarum*, and *P. triticina* was found in the northern wheat tract, but in no case was the damage of any economic importance. The seasonal

incidence of the disease was late (March 1922). The presence of *Fusarium* root rot and ear blight of wheat (reported from Hoshangabad in 1919) was not confirmed.

Gram [chick pea: *Cicer arietinum*] was attacked by an apparently undescribed *Fusarium*. In parts of Berar the wilt of *Cajanus indicus* caused by *Fusarium udum* is common.

Rice suffers from several obscure diseases characterized by partial or complete sterility of the ear. Some of these are believed to be due to insects and others to *Sclerotium oryzae*, but in some cases the cause is quite unknown.

A wilt disease of linseed, the cause of which is unspecified, occurred. Flax rust (*Melampsora lini*), which sometimes causes serious loss in the Central Provinces, was only once reported. A *Rhizoctonia* root rot of *Sesamum indicum* was also reported.

Groundnut [*Arachis hypogaea*] was attacked by a *Rhizoctonia* root rot and a leaf spot due to *Cercospora* sp.

The most prevalent diseases of sugar-cane were red rot (*Colletotrichum falcatum*) and smut (*Ustilago sacchari*).

The chief diseases of potato were root and tuber rots due to *Rhizoctonia solani* and *R. destruens* [*Sclerotium rolfsii*].

WELSFORD (Miss E. J.). **Abstract of Mycologist's Annual Report.**—*Ann. Rept. Dept. Agric. Zanzibar, 1922*, pp. 7–8, 1923.

The following notes deal, in an abridged form, with the main points of the Mycologist's Report, which will be submitted in full at the expiry of her term.

There are now only about 3½ million clove trees in the Protectorate, many having died in recent years, especially in Pemba. Investigations showed that two fungous diseases were responsible for most of the deaths. The more important of these is a root rot disease causing the symptoms known locally as 'sudden death'; the second is more widespread but less virulent, and results in a defoliation of the twigs termed 'die-back' [see this *Review*, ii, p. 355].

The causal organism of root rot is stated to be a soil saprophyte capable, under certain conditions, of attacking living clove roots. Having once obtained an entrance into the small, fibrous roots, the fungus gradually destroys them and spreads into the larger roots and base of the trunk. The destruction of the fibrous roots cuts off the water supply and results in the death of single branches, or, in severe cases, of the whole tree. The mycelium of the fungus forms a layer under the bark and, as the wood dries, fruiting bodies possibly belonging to it form near the surface of the soil where aeration is better. The disease is very infectious and is spread chiefly by the contact of diseased and healthy roots. The spores are also disseminated by ants and various animals. Infected trees should be felled and removed on the first signs of wilting, the main roots and stumps being thoroughly charred to prevent spore formation. The stump and its immediately neighbouring trees should be isolated by a trench 2½ ft. deep, the ground being dressed with 1 lb. of lime per sq. yd. Poor cultivation is a predisposing factor.

Die-back, which is very common on trees growing in exposed situations, is due to a wind-borne fungus entering the leaves

through the stomata. Only those leaves the surface of which has been previously roughened by the alga *Cephaleuros mycoidea* are attacked. Both fungus and alga can be destroyed by spraying with Bordeaux mixture, and their attacks may be minimized by careful pruning and good cultivation.

Årsberättelse över verksamheten vid Centralanstalten för försöksväsendet på jordbruksområdet under år 1922. [Annual report on the work of the Central Agricultural Experiment Station during the year 1922.]—*Kungl. Landtbr.-Akad. Handl. och Tidskr.*, lxii, 4, pp. 357–388, 1923.

The section of the report devoted to agricultural botany (pp. 378–381) is contributed by Prof. E. Henning.

The following fungous diseases were reported to cause considerable damage in various parts of Sweden. The snow fungus [*Fusarium nivale*] on rye in the central districts; yellow rust of barley [*Puccinia glumarum*] in Norrland; stripe disease of barley [*Helminthosporium gramineum*] in Jämtland and Västmanland; oat smut [*Ustilago avenae*] in Halland; mildew of rye and barley [*Erysiphe graminis*] in several localities; gooseberry mildew [*Sphaerotheca mors-uvae*] in Kalmar; potato blight (*Phytophthora* [*infestans*]) and club-root [*Plasmodiophora brassicae*] in many parts of the country. Among physiological diseases the so-called grey speck of oats [see this *Review*, ii, p. 403] occurred in a severe form in various districts.

Certain difficulties, which are briefly discussed, were encountered in the application of the regulations of 4th Nov. 1921 [see this *Review*, i, p. 128] relating to the inspection of potatoes for wart disease [*Synchytrium endobioticum*]. Owing to the lack of trained inspectors, the work on the Swedish-Norwegian frontier (where small transactions in potatoes are extensively conducted) could not be properly carried out. A meeting between Professor Henning and the Norwegian State Mycologist was therefore arranged to deal with the matter. The former has submitted to the committee of the Central Experiment Station proposals for certain alterations in the existing regulations. The bulk of the potato exports were destined for Norway and England; according to a report from Malmö some of the consignments to the latter country, where there was an acute potato shortage at the time, escaped inspection.

McLarty (H. R.). **Field Laboratory of Plant Pathology.**—*Agric. Journ. Brit. Columbia*, viii, 7, pp. 150–151, 3 figs., 1923.

A brief popular account is given of the investigational and administrative work carried on at the Summerland Laboratory, British Columbia (one of the nine branches of the Ottawa Central Laboratory established since 1912).

Eastham (J. W.). **Report of Provincial Plant Pathologist, Vancouver.**—*Seventeenth Ann. Rept. Dept. Agric. Brit. Columbia for the year 1922*, pp. 66–70, 1923.

Sclerotinia disease of sunflowers occurred in the Fraser Valley during the autumn.

Mosaic of red raspberries [see this *Review*, ii, p. 17] threatens to

become a serious menace to the small fruit industry, being especially severe on the excellent commercial Cuthbert variety.

White pine blister rust [*Cronartium ribicola*] was found on Valdes and Cortes Islands in the vicinity of cultivated black currants. Cases were also seen in the Pender Harbour and Grassy Bay regions, but in these the infection could not have spread to the pine from cultivated *Ribes*. Some of the severest infestations, in fact, were absolutely remote from cultivation. A vigorous campaign of scouting is proceeding, which resulted, on 28th August 1922, in the discovery of the disease east of the Cascade Mountains. It is hoped that the voluntary system of eradication of black currants will shortly be reinforced by legal measures.

Blackleg of potatoes (*Bacillus phytophthorus*) [*B. atrosepticus*] was very prevalent both in irrigated and non-irrigated sections.

Careful inspection of potato tubers showing stem-end browning revealed the fact that the latter condition was by no means necessarily associated with wilt infection, which is much more easily recognized in the growing crops. The potato varieties grown for seed in the Columbia Valley area, namely, Cambridge, Russet, and Wee McGregor, were noticeably free from *Fusarium* wilt.

Biological Division.—*Ann. Rept. Dept. Agric. Mauritius for the year 1922*, pp. 7–8, 1923.

The disease of filao [*Casuarina equisetifolia*: see this *Review*, i, p. 154] was again observed in a few localities, in a lesser degree, however, than during the previous years. The experimental plot at Le Bouchon, where diseased areas were replanted in filao in 1920, has developed normally and shows no sign of infection.

Citrus canker (*Pseudomonas citri*) occurred in its most virulent form at Belle Rive, wiping out practically the entire lime plantation.

Sugar-cane smut (*Ustilago sacchari*) seriously affected certain imported varieties, chiefly Indian.

Potato blight (*Phytophthora infestans*) and other fungous diseases of vegetables were extremely prevalent in 1922.

DUFRÉNOY (J.). **Gommose locale et générale résultant des lésions bactériennes des feuilles.** [Local and general gummosis resulting from bacterial lesions of leaves.]—*Comptes Rendus Soc. de Biol.*, lxxxviii, pp. 122–124, 6 figs., 1923.

The author states that various bacteria penetrating through the stomata of leaves and causing lesions such as the foliage stains of melon similar to those caused by *Bacterium lacrymans*, ivy leaf canker of the 'Epheukrebs' type as observed by Lindau, and bacterial cankers of *Mimosa phyllodes*, bring about a local gummosis of the infected chlorenchyma accompanied by the destruction of the chloroplasts. The cells in the centre of such an infected spot enlarge to form a canker, and their walls become suberized. A translucent area surrounds this, and the vascular and secretory tissues in the neighbourhood degenerate, the vessels becoming delignified and occluded by gum. Gummosis of the leaf tissues can take place at some distance from the point of infection in the same way as is already known to occur in roots and stems.

Departmental Activities: Botany.—*Journ. Dept. Agric. S. Africa*, viii, 1, pp. 12–13, 1923.

Fruit growers are stated to have suffered heavy losses recently from crown gall [*Bacterium tumefaciens*] after planting stone fruit trees budded on peach stocks. Most of these died after a few months and bore typical galls on the crowns or on the roots, the indications being that the trimming by nurserymen had been done with infected tools. The disease apparently develops very rapidly in trees which become infected in the nursery in the western part of the Cape Province, and are subsequently planted in the eastern Cape districts and in the Transvaal, where there is usually a heavier type of soil and a summer rainfall.

It is recommended that all young trees be examined carefully for crown gall, all trimmed roots being cut back further, and the plants dipped in a 2 per cent. solution of copper sulphate for ten minutes, before planting. All trees showing galls on the crown or roots should be rejected.

LEVINE (M. N.) **A statistical study of the comparative morphology of biologic forms of Puccinia graminis.**—*Journ. Agric. Res.*, xxiv, 7, pp. 539–567, 2 pl., 14 graphs, 1923.

The object of this work was to determine the morphological characters of the different biologic forms of *Puccinia graminis*. For this purpose, measurements of the aecidiospores, uredospores, and teleutospores were made of the following biologic forms: *tritici*, *secalis*, *avenae*, *phleipratensis*, and *agrostis*.

Details are given of the experimental methods employed. In the case of aecidiospores a minimum of 50 measurements was required, and for uredo- and teleutospores at least 100 were necessary. Biometric methods were used in order to ascertain the significance of the variations discovered. The important factor in determining the value of numerical differences consists in the relationship between these differences and the probable error in their determination, previous authors stating that a difference may be considered significant only when it exceeds its probable error by more than three times.

Dealing first with aecidiospores, *P. gr. tritici* has mean spore measurements of $19{\cdot}72 \pm 0{\cdot}19$ and $15{\cdot}66 \pm 0{\cdot}10$, forma *secalis* $17{\cdot}10 \pm 0{\cdot}19$ and $13{\cdot}46 \pm 0{\cdot}11$, f. *avenae* $18{\cdot}62 \pm 0{\cdot}11$ and $14{\cdot}70 \pm 0{\cdot}10$, f. *agrostis* $16{\cdot}46 \pm 0{\cdot}18$ and $12{\cdot}98 \pm 0{\cdot}09$. No aecidia of f. *phleipratensis* could be produced on barberry. The uredospores had the following measurements: f. *tritici* $32{\cdot}40 \pm 0{\cdot}19$ and $19{\cdot}79 \pm 0{\cdot}06$, f. *secalis* $27{\cdot}14 \pm 0{\cdot}14$ and $17{\cdot}19 \pm 0{\cdot}06$, f. *avenae* $28{\cdot}50 \pm 0{\cdot}15$ and $19{\cdot}94 \pm 0{\cdot}07$, f. *phleipratensis* $23{\cdot}95 \pm 0{\cdot}12$ and $16{\cdot}88 \pm 0{\cdot}06$, and f. *agrostis* $22{\cdot}37 \pm 0{\cdot}12$ and $15{\cdot}68 \pm 0{\cdot}05$. The teleutospores were $51{\cdot}80 \pm 0{\cdot}49$ and $16{\cdot}67 \pm 0{\cdot}12$, $47{\cdot}35 \pm 0{\cdot}45$ and $14{\cdot}77 \pm 0{\cdot}12$, $46{\cdot}15 \pm 0{\cdot}43$ and $15{\cdot}84 \pm 0{\cdot}12$, $41{\cdot}30 \pm 0{\cdot}32$ and $15{\cdot}63 \pm 0{\cdot}10$, and $40{\cdot}30 \pm 0{\cdot}40$ and $14{\cdot}64 \pm 0{\cdot}12$ respectively. Tables are given summarizing the differences in the means of spore measurements of biologic forms and giving the difference in means divided by the probable error of the difference. Except in forms with spores very much the same size, the differences are well above the limit required. The spores of f. *tritici* are seen to be larger than those of any other

biologic form, f. *avenae* occupies the second place, f. *secalis* the third, f. *phleipratensis* the fourth, and f. *agrostis* has the smallest spores of all. The differences in size do not occur in any consistent direction, nor do they follow a logical sequence. In some cases the spores of two biologic forms may vary both in length and width, in other cases the differences may be in one direction only.

Congenial hosts do not in any way change the morphology of *P. graminis* spores. A single host common to several biologic forms cannot unify them in size or shape, nor can several hosts, equally susceptible to one form, exert any influence on the spore morphology of this form.

Resistant hosts and unfavourable environmental conditions tend to reduce the size of any type of spores of any biologic form, most frequently in spore length only, but sometimes in both length and width. If, however, normal conditions are re-established, the spores of the next generation will attain normal dimensions. The ill effects of excessive heat, insufficient light, and deficient soil moisture were quite definitely proved for uredospores, and probably aecidio- and teleutospores are similarly affected.

Besides differences in spore size, differences in shape of the various biologic forms were also noted. The statistical data necessary to express the significance of the differences, however, were not available.

STAKMAN (LOUISE J.). **Some fungi causing root and foot rots of cereals.**—*Res. Publ. Univ. Minnesota, Studies in Plant Sci.*, pp. 140–153, 3 pl., 1 fig., 1923.

This paper describes in detail the effect of certain Fungi Imperfecti on the roots of cereals (oats, rye, and wheat) grown in agar containing Sach's modified nutrient solution. A few pot cultures were also made, sterile seedlings being grown in sterile white sand and then inoculated.

The most common sign of disease was a marked shortening of the main roots, often accompanied by a decrease in diameter and sometimes by an almost entire absence of branching. The colour of the affected roots was generally grey, brown, or mottled. The leaves of diseased seedlings appeared normal except when the whole plant was blighted, as in the case of attack by *Fusarium* and *Sclerotinia*.

The specific effects of the nine parasitic fungi used in the experiments are described in detail. *Alternaria* strains belonging to two general types, with differing cultural characters and degrees of virulence, were isolated from cereals and from the soil. One type produced a dull, greenish-black mycelium, which sporulated luxuriantly in culture and caused a grey, later greenish-black discoloration of the roots. The second type grew more sparingly, sometimes forming only a thin, powdery coating of spores on the surface of the medium, and produced a brown discoloration of the roots. The former, which was the more virulent, was generally found in the seeds, and the latter in other parts of the plant and in the soil. It is estimated that at least 20 per cent. of the supposedly sterilized seeds planted on agar had to be discarded on account of saprophytic or parasitic forms of *Alternaria*.

Roots infected by *Alternaria* showed a hyaline or dark green mycelium, most abundant in the epidermis, spreading as far as the endodermis, and eventually intracellular. Local areas consisting of a few epidermal or cortical cells were disintegrated. The cell walls were broken down and the cavities thus produced filled with matted hyphae.

Botrytis sp., isolated from a rye seedling, produced on inoculated roots a slight brown discoloration with vertical black lines, up to 1 mm. in length, scattered over the upper half. A cross section through one of these lines showed a wedge of discoloured tissue, wider at the epidermis and gradually narrowing through the cortex. Similar symptoms were observed in the field. The mycelium, which resembled that of *B. compacta*, was mostly intracellular, hyaline at first and then dark green. The walls between severely attacked host cells were frequently broken down, the interstices being filled with numerous vertical, sporulating conidiophores.

Colletotrichum phomoides was isolated from a tomato and proved to be somewhat parasitic on wheat and oats. Infected roots were slightly shorter than the normal, and sometimes greyish-brown in colour, especially in oats. Punctiform stromata were produced on oats and occasionally on durum wheat. The roots were covered with a mycelial growth, and inter- and intracellular hyphae penetrated the tissues as far as the endodermis. Haustoria were sometimes sent into the cells, especially in oats. In durum wheat fuliginous secondary spores (appressoria) were formed. The cell walls were not much disorganized.

Fusarium culmorum, obtained from scabby wheat seeds, produced the well-known symptoms of blight on wheat seedlings. The plants were stunted and the roots short, mottled brown, shiny, tapering, and little branched. The vascular tissue was generally infected first; in the cortex the mycelium was chiefly intercellular and in the stele intracellular. Pockets filled with mycelium were formed in the disorganized cell walls.

Gliocladium sp., isolated from the soil, caused a brown discoloration of the shortened roots of infected plants. The irregular, hyaline hyphae wound spirally around the walls of the epidermal and cortical cells and sent haustoria into the lumina, eventually causing the disintegration of the contents. Young branches and root tips were readily infected. The fungus closely resembles and may be identical with *G. viride*.

Rhizoctonia solani, isolated from rye and potato, was tested. Inoculations with the potato strain gave negative results with oats but produced a diseased condition in a few durum seedlings in which the hyphae penetrated into the cells. Rye seedlings inoculated with the rye strain were distinctly weakened and showed a slight yellowing of the leaves due to an abundant, though superficial, growth of mycelium at the base of the culm.

Sclerotium rolfsii from an unknown source quickly killed most of the seedlings inoculated with it. A dark ring appeared at the base of the culm, and the large, irregular hyphae spread throughout the weakened tissues, including those of the roots.

Tilachlidium sp., frequently isolated from wheat seedlings, produced a cream-coloured to brown discoloration and abnormal

branching of the roots, which were reduced in thickness and sometimes short and blunt. The extremely fine hyphae, which were most difficult to detect, were chiefly intracellular. The inner parts of the cortex were most often and heavily attacked, but the stele was also entered. Partial disintegration was observed in the vessels of several roots.

Trichoderma köningi, originally obtained from the soil of a potato field, produced a stunting and brown discoloration of durum wheat roots. The diseased tissues usually formed a more or less uniform ring in the cortex, one or more cells thick. The hyphae, which were medium-sized outside the host tissue, became very fine within it. Conspicuous chlamydospores, however, were formed in the cells. The growth was chiefly intracellular. The walls of the diseased cells turned brown and later became full of a brownish, granular substance, pockets being eventually formed and the outer layers of the root disintegrated.

The results of these experiments support Bolley's conclusions [*North Dakota Agric. Exper. Stat. Bull.* 87 (1910) and 107 (1913)] that the cumulative effect of fungi, such as those dealt with above, on cereal roots is of considerable importance in weakening the vigour of the plants.

McKinney (H. B.). **Investigations on the rosette disease of Wheat and its control.**—*Journ. Agric. Res.*, xxiii, 10, pp. 771–800, 8 pl. (1 col.), 2 graphs, 1923.

The disease known as 'so-called take-all' or 'rosette' of winter wheat was first reported from Illinois in 1919, and was subsequently found in Indiana. At first believed to be identical with the foot rot or take-all disease caused by *Ophiobolus cariceti*, it was soon found to be distinct, and, being restricted to relatively small areas, has proved to be a less serious menace than the former. Under ideal conditions in the field, it has caused up to 40 per cent. loss of grain, and up to 75 per cent. in experimental plots, but sometimes affected plants recover and yield some late grain.

Rosette has, so far, been found only on certain varieties of winter wheat. Its incidence may be uniform throughout the field, or in spots or patches unconnected with any type of soil or topographical features. Its chief symptoms are an arrested spring development of the plant, excessive tillering resulting in a 'rosette' appearance, and a dark blue-green colour of the leaves. These characters serve to distinguish it from the disease caused by *Ophiobolus cariceti*. At a later stage the base of the shoots may turn brown (but without the dark plate of fungous tissue found in true take-all) and the whole base of the plant may become rotten, this condition being probably secondary and not a constant feature of the disease.

The cause of the disease is unknown. The symptoms are regarded as presenting a certain similarity to those of the Fiji, sereh, and mosaic diseases of sugar-cane and to maize mosaic. Yellowish-brown, necrotic areas are found in the inner parenchyma at the base of the stunted tillers, and intracellular bodies, very similar to those that have been described in tobacco, sugar-cane, and maize mosaic [see this *Review*, i, pp. 194, 394, and ii, p. 241], and to those

found in Fiji disease of sugar-cane, were observed in the cells in and around these necrotic areas. On the other hand, soil disinfection tests have proved that the disease can be completely controlled by applying 2 per cent. formalin or by steam sterilization. Neither winter injury nor soil conditions were found to have any direct connexion with rosette, nor could any influence on it be detected from the series of tests with fertilizers, nor in rotation tests. There is no indication that insects are responsible for the disease, and no fungus has hitherto been detected regularly associated with it.

It has been proved that the disease is soil borne, and the causal agent, which is supposed to be an organism or virus, is known to persist in summer-fallowed land for at least two years, and can be transferred with infected soil to uncontaminated plots. Certain field observations indicate that it is also seed borne.

Definite susceptibility to rosette has been exhibited by only 6 per cent. of the wheat varieties and selections tested, and the control of the disease by the use of resistant varieties is completely practicable.

STÄGER (R.) **Impfversuche mit dem Mutterkorn des Weizens.** [Inoculation experiments with ergot of Wheat.]—*Mitt. naturforsch. Gesellsch. Bern, 1922*, pp. 11–20, 1923.

The author carried out some experiments to elucidate the comparative immunity of wheat from *Claviceps purpurea* which he had observed in certain mixed stands of wheat and rye, where the latter was very heavily infected.

Wheat ergot, bearing numerous viable conidia on the sclerotia, was received from the United States in 1920. Inoculations with conidial suspensions were successful on *Anthoxanthum odoratum*, *Dactylis glomerata*, and *Arrhenatherum elatius*, which are known to be hosts of the rye strain of *Claviceps purpurea*. Further inoculations on rye were also successful, leaving no doubt of the identity of the fungus.

Attempts were then made to inoculate wheat by injecting the conidial suspension through a hypodermic syringe so as to reach the style and ovary of the grain. These were fully successful.

The author explains the rare occurrence of *C. purpurea* on wheat as being the result of the brief (usually less than 15 minutes) and irregular opening of the glumes at maturity, the susceptible parts of the flower being ordinarily protected (especially in spelt wheat) by the closed glumes. The flowers of rye, on the other hand, remain open and liable to infection for hours.

REED (G. M.). **Varietal resistance and susceptibility of Sorghums to Sphacelotheca sorghi (Link) Clinton and Sphacelotheca cruenta (Kühn) Potter.**—*Mycologia*, xv, 3, pp. 132–143, 2 pl., 1923.

The experiments recorded in this paper supplement those of the author and Melchers elsewhere published, and extended to varieties belonging to all the seven main groups of sorghum (broom corn, durra, kafir, kaoliang, milo-feterita, shallu, and sorgo) as well as to such unclassified forms as darso, hegari, and kafirita. The varieties

of broom corn, durra, kafir, and sorgo proved to be quite susceptible to *Sphacelotheca sorghi*, but as a rule the percentages of infection were somewhat lower than those obtained in previous years, and in a few cases varieties hitherto found to be susceptible gave negative results. As before, darso, feterita, kafirita, milo, and Sudan corn varieties proved entirely resistant, while little or no infection was secured with several kaoliangs, e. g. Barchet, Brown, and Manchu seed No. 119. Manchu 191 and Valley kaoliang, however, gave relatively high percentages of infection. Dwarf kaoliang was again found to be entirely resistant.

The results with *S. cruenta* closely corresponded with those mentioned above, but a striking difference between the infecting capacities of the two smuts occurred in the case of darso, four strains of which showed total immunity from *S. sorghi*, while two of these strains gave a considerable number of plants (19 out of 45) infected with *S. cruenta*. The results with Dwarf milo differ entirely from those obtained by Kulkarni (*Phytopath.*, xi, p. 252, 1921) who states that he secured 50 infected heads out of 645, a percentage of 7·8, whereas in the present experiments, 99 plants of Dwarf milo belonging to three different strains were grown and none of them was successfully infected.

S. sorghi and *S. cruenta* produce quite different effects on the host plants. Plants infected with the former headed out at the normal time, were of normal height, of normal appearance, with normal glumes, and heads of about normal size, while the sori were confined to the flowers. Plants infected with the latter headed out much earlier than normally, were 6 in. to 1 ft. below normal size, showed a marked tillering, marked enlargement of the glumes, more slender and somewhat more closely arranged heads, and bore sori on the pedicels or other parts of the panicle as well as the flowers. Differences in the smut balls (which are conical and thick-walled in *S. sorghi* and cylindrical and thin-walled in *S. cruenta*) and in the central columellae (much longer, more slender and curved in *S. cruenta*) are also noted.

A bibliography of thirty-four titles is given.

BEDFORD (H. W.). **The pests of Cotton in the Anglo-Egyptian Sudan.**—*Wellcome Trop. Res. Lab. Entom. Sect. Bull.* 19, 38 pp., 1923.

While dealing principally with the insect pests of cotton, the *Bulletin* contains some references to fungous diseases in the Sudan. *Aspergillus niger* is stated frequently to gain admission to the bolls injured by the Egyptian bollworm (*Earias insulana*) or the pink bollworm (*Gelechia gossypiella*), attacking the lint and seeds and sometimes converting the interior of the boll to a black decaying mass. Similar damage is said to be also caused by a species of *Capnodium*.

Wilt produces symptoms resembling those of drought although the soil may contain abundant moisture. The cortical tissues of the root and stem decay, and the stem becomes fibrous and disintegrates. Sometimes the plants recover and put out fresh foliage, at others they succumb to the disease. The cause of the disease is stated to be unknown.

RUSCHMANN (G.). **Taurösterreger.**—[Dew retting agents.]—*Faserforsch.*, iii, 1, pp. 22–40, 1923.

The results of experiments at the Sorau Experiment Station showed that *Rhizopus nigricans* is not such an important agent of dew retting as is generally accepted. It was completely absent on flax obtained from various parts of Germany, and on hemp [*Cannabis sativa*] it was also less conspicuous and active than other organisms.

A new retting agent, *Mucor plumbeus*, which occurs at least as frequently as *R. nigricans*, was found. It showed approximately the same degree of activity as the latter.

Cladosporium herbarum displayed considerably greater retting capacity than either of the above-mentioned fungi. Its spores were present on all the specimens of flax and hemp examined.

At a temperature of 8° C. (winter retting) *Mucor hiemalis*, hitherto believed to be active, was present neither on flax nor hemp. *R. nigricans* and *M. plumbeus* did not develop at this temperature and the work was carried on almost entirely by *C. herbarum*.

Under field conditions the active participation of retting bacteria is almost entirely inhibited owing to their inability to withstand humidity. This is particularly true of the anaerobic *Bacillus amylobacter*. Under favourable conditions they are capable of accomplishing the whole process of retting, but in the open air *C. herbarum* was found to be the principal agent.

RUSCHMANN (G.). **Entwertung des Schwungflachses durch Mikroorganismen.** [The depreciation of scutched Flax by micro-organisms.]—*Faserforsch.*, iii, 2, pp. 131–161, 4 figs., 1923.

Bacillus amylobacter, the anaerobic retting agent, was found to remain viable even on artificially dried fibre. A slight damping of the fibre resulted in the development of specific aerobic bacteria and fungi, e. g. *Bacillus mesentericus*, *B. megatherium*, *Rhizopus nigricans*, *Mucor corymbifer*, *Aspergillus*, and *Penicillium*. These organisms caused considerable damage to the fibre by the dissolution of the pectic substances and cellulose, resulting in the disintegration of the cells. The number of anaerobic organisms was reduced by damping the fibre.

Flax stored under unsuitable conditions is very liable to absorb moisture from the air. It should be kept in light, dry, and well-ventilated rooms and not sprinkled. In the author's opinion the water-content for flax at present permissible under commercial regulations, namely, 12 per cent., is too high. By reason of its anatomical structure, composition, and the high percentage of organisms present on it, flax is more liable to depreciation by the action of micro-organisms than cotton. The permissible water-content for cotton, however, though it is not nearly so hygroscopic as flax, is only 8·5 per cent. The drying of flax should form a regular branch of the routine of preparation, as it already does in the case of silk and cotton.

BOERGER (A.). **Leinsaat und Flachs am La Plata.** [Linseed and Flax on the La Plata.]—*Faserforsch.*, iii, 2, pp. 73–112, 15 figs., 1 diag., 1923.

Flax and linseed are stated to suffer from wilt in Uruguay. Though the disease is attributed in other countries to *Fusarium lini*, the author thinks that the Uruguayan form is chiefly due to soil and other environmental conditions.

Rust (*Melampsora lini*) is stated to have been observed to cause the entire loss of the flax crop in seasons favourable to its attack.

FOËX (E.) & CHABROLIN (C.). **Les maladies des arbres fruitiers et leurs traitements.** [Fruit tree diseases and their treatment.]—*Prog. Agric. et Vitic.*, xl, 36, pp. 249–257; 37, pp. 274–278; 38, pp. 303–307; 39, pp. 328–333; 3 col. pl., 1923.

This paper contains brief descriptions of the principal fungous diseases affecting fruit trees in France; apples, pears, peaches, apricots, cherries, plums, and almonds are dealt with under separate sections. *Fusicoccum amygdali* and *Polystigma ochraceum* on the almond and *Sphaeropsis pseudodiplodia* on the apple and pear are noteworthy diseases referred to. The articles are written especially for fruit growers, and the treatment of the diseases is discussed at some length. Copper fungicides are generally recommended in preference to lime-sulphur on account of their greater efficiency, though it is sometimes advantageous to use the latter owing to its relative cheapness. Bordeaux mixture is preferable to Burgundy for orchard work, and the more alkaline mixtures are recommended; the weight of the lime should be at least equal to that of the copper sulphate. The preparation of different mixtures is discussed in some detail.

TRABUT (L.). **Arboriculture fruitière dans le nord de l'Afrique. Le Figuier (suite). Ennemis et maladies du Figuier.** [Fruit tree cultivation in North Africa. The Fig tree (continuation). Pests and diseases of the Fig tree.]—*Bull. Agric. de l'Algérie-Tunisie-Maroc*, 2nd Ser., xxix, 7, pp. 117–124, 1923.

The fungous diseases affecting fig trees in North Africa are briefly described and remedial measures indicated. Like other trees in this area, fig trees are subject to root rot in damp, impermeable soils. The remedy is careful attention to drainage. Fructifications of *Armillaria mellea* are frequently seen at the base of the hollow and decaying trunks of the trees, and *Pleurotus ostreatus*, *Fomes fici*, and *Ceriomyces fici* also occur. Very frequently the leaves bear rust (*Uredo fici*), which occasionally causes a yellowing and falling of the foliage. *Cercospora bolleana* is not infrequent in the Mediterranean basin, but is rarely met with in Algeria; it generally attacks only the leaves, but young fruit may also be affected. *Botrytis grisea* may attack fig trees and cause serious loss, especially in damp districts, but it also is rare in Algeria. Sooty mould, due to the presence on the leaves and fruits of honey-dew secreted by scale insects, is found at times.

Barss (H. P.). **Mushroom root rot of fruit trees.**—*Seventeenth Biennial Rept. Oregon Board of Hort.*, pp. 171–176, 6 figs. 1923.

Mushroom root rot (*Armillaria mellea*) causes very considerable damage in the orchards of western Oregon. The most obvious symptoms of the disease are yellowing of the foliage, reduced growth, and sudden excessive bearing, followed by death of the tree. The diseased bark has a noticeable mushroom-like odour, and sections of the larger roots show whitish flecks of fungous tissue throughout the bark. In most cases a white fungous layer, forming fan-like designs, lies between the dead bark and the wood. Almost invariably the outside of the attacked roots and crown of the tree is covered with black or dark purple, shiny, irregular rhizomorphs.

The disease, though extremely difficult to control, may be combated to some extent by a thorough clearance of the soil, the excision of the diseased bark and rhizomorphs, and subsequent application of Bordeaux paste. The bases of treated trees should be left exposed throughout the summer to air and light. The surrounding trees may be protected by digging trenches at least a foot in width between the diseased area and the rest of the orchard. All roots crossing the trenches should be cut off. The soil can then be thrown back or a concrete wall built in the trench.

The French pear root stock (*Pyrus communis*) and the northern California black walnut stock [*Juglans hindsii*] are highly resistant to *A. mellea*, while the common English walnut [*J. regia*] is very susceptible.

Mally (C. W.). **Detecting imperfections in fruit by means of X-rays.**—*Journ. Dept. Agric. S. Africa*, vii, 2, pp. 112–116, 3 pl., 1923.

The great importance of being able to eliminate unsound fruit from shipments led the author to experiment with X-rays as a means of detecting fruit decay. The material examined included peaches, pears, oranges, and pineapples.

The radiographs gave clear evidence of insect injuries in the fruit. Pear scab spots (*Venturia pirina*) were not revealed with certainty, but on the other hand blue mould (*Penicillium digitatum*) showed clearly in an affected orange, 'end-rot' of an orange being also brought out distinctly by the X-rays.

The results are considered to justify the hope that a suitable X-ray apparatus will be devised which can be used by the farmer in packing his fruit as well as for inspection purposes at the docks.

Brown (W. S.). **Heart rot.**—*Seventeenth Biennial Rept. Oregon Board of Hort.*, p. 165, 1922.

The control of heart rot, the most severe menace to Oregon fruit trees [see this *Review*, i, p. 62] may be effected by the thorough protection of pruning and other wounds and abrasions, through which the decay organisms gain admission. Wounds from one to two inches in diameter should be covered with Bordeaux paste. The outer bark region of larger wounds should receive a preliminary coating of eight parts of asphaltum and two of paraffin,

after which Bordeaux paint should be applied to the centre of the wound. Lead paint is not only useless but actually injurious, since it increases the probability of infection by holding moisture on the cut.

ZELLER (S. M.). **European canker of Apple and Pear—its control.**—*Seventeenth Biennial Rept. Oregon Board of Hort.*, pp. 155–158, 5 figs., 1923.

European canker (*Nectria galligena*), the symptoms of which were described in an earlier paper [see this *Review*, i, p. 217], has become a very serious disease in western Oregon, especially on pears of the Bosc, d'Anjou, Howell, and Surprise varieties.

Preliminary experiments in the control of the disease indicate that, besides the excision of cankers, the application of Bordeaux mixture 4–4–50 or 6–6–50 in the autumn is likely to reduce infection.

ZELLER (S. M.). **Cytospora canker of Apple and Pear.**—*Seventeenth Biennial Rept. Oregon Board of Hort.*, pp. 162–164, 4 figs., 1923.

The canker of apples and pears due to species of *Cytospora* is very prevalent in western Oregon. The bark of infected trees at first shows a reddish discoloration, in patches which soon become sunken and with a wrinkled skin which peels and splits along the purplish margins. The fruiting bodies appear as small pustules, from which are extruded long coils or 'sporehorns' composed of spores embedded in a gelatinous substance. There are evidently three species of *Cytospora* on the pear and apple trees of Oregon, having reddish-orange, lemon-yellow, and white 'sporehorns' respectively.

Cytospora canker is found almost exclusively on trees weakened by frost or other causes. It may be controlled by excision of the affected areas and painting the exposed wood with one of the dry Bordeaux mixtures.

Opbevaring af Æbler og Pærer. [Storage of Apples and Pears.]—*Tidsskr. for Planteavl*, xxix, 3, pp. 329–394, 4 diag., 1923. [English summary.]

The results of investigations on the storage of fruit carried out since 1918 by the Danish State Plant Cultivation Service (Experimental Branch) may be summarized as follows.

The keeping quality of fruit stored under uniform conditions varied greatly from year to year. All the varieties of apples and pears tested kept much longer in cold storage than in cellars. The period of keeping was increased by two to three months by prompt storage of the fruit at a temperature of 1·5° to 0·5° C. After removal from cold storage in winter the fruit kept at least a fortnight, or as long as was generally necessary for marketing and transport. Nouveau Poiteau, however, proved an exception to this rule, developing core rot in 1919–20 a few days after removal from storage.

In specially constructed fruit houses, with constant through draughts and ventilation, a detailed account of which is given, the

fruit kept much better than in cellars, approximately in the same proportion as the temperature was lower in the former than in the latter.

The flavour of apples did not appear to be affected by the temperature or length of storage. On the other hand, pears gathered before they were tree-ripe were inferior in flavour after storage at low temperatures. Even when gathered at the correct time their flavour is somewhat impaired by long cold storage, but this defect can be remedied by placing them in a warm room for a few hours before eating.

Ventilation with fresh air, and the installation of a special apparatus for the generation of ozone in the cold storage rooms, do not appear to have improved the keeping qualities of pears, but the experiments with these systems have only been carried out once and apples have not yet been tested.

Scabbed fruit did not keep nearly so well as healthy, the spots frequently giving access to *Gloeosporium album*, which also, however, attacked the fruit independently of scab injury.

Wrapping in tissue paper did not influence the keeping quality of the fruit, but gave it a more attractive appearance.

Experiments in packing the fruit in fine, dry, powdered peat resulted in a prolongation of the keeping period by about a month.

The size of the fruit affected its keeping qualities, large fruit being more liable than small to decay in storage.

Bruised fruit (one year's experiments only) did not keep so well as the uninjured.

BARSS (H. P.). **Bacterial gummosis of Cherry.**—*Seventeenth Biennial Rept. Oregon Board of Hort.*, pp. 152–154, 2 figs., 1923.

Bacterial gummosis [*Bacterium cerasi* Griffin (*Pseudomonas cerasus* Griffin); see this *Review*, i, p. 379, and ii, p. 393] is the greatest problem in young sweet cherry orchards in Oregon, which become infected soon after planting. The disease reaches a climax between the fourth and the seventh year, but older orchards in full bearing suffer little loss, although the causal organism is seldom, if ever, eradicated.

The active phase of the disease is almost entirely confined to the dormant season, although the gumming may continue after the recommencement of fresh growth. Under Oregon conditions the first infections take place during the heavy autumn rains, the disease probably being transmitted by certain insects which puncture the bark and buds and inoculate them with bacteria. During the winter there is scarcely any external evidence of the destruction of the tissues which is proceeding within. In the spring or summer large dead areas may be observed on the trunk or branches. Coinciding with the gum formation in early spring is a dark discoloration and desiccation of the affected bark and buds. These effects are often very similar to those produced by freezing.

Only two methods of control are known. The first, the excision of diseased tissues and disinfection of the wound, is laborious and

difficult. The second is the use of resistant stocks, preferably the Mazzard sweet cherry seedlings. At two or three years of age these stocks should be grafted or budded over on to the desired commercial variety. In such limb-grafted trees, even the wood of the susceptible scion is far less affected by the disease than when borne on a susceptible frame.

Of the three varieties of sweet cherry commonly cultivated in Oregon, Bing and Royal Ann are highly susceptible and Lambert relatively resistant. The Duke type is almost, and sour cherries are quite, immune.

DOIDGE (ETHEL M.). **A fungus of economic importance on the Avocado (Persea americana).**—*Bothalia*, i, 3, pp. 179–186, 7 figs., 1922. [Received 1923.]

Avocado trees in the Louis Trichardt district of the Transvaal were found in 1921 to be suffering from a fungous disease which produced symptoms on the limbs and twigs resembling those caused by *Physalospora cydoniae* on the apple.

In the earlier stages of infection the bark becomes sunken and discoloured, the diseased area gradually increasing and girdling the branch. Small branches, not exceeding 2 to 3 in. in diameter, are killed, while extensive cankers are formed on the larger limbs and trunk. The boundary between the healthy and diseased tissue is marked by a raised, reddish-brown line. Numerous fruiting pustules of the fungus are scattered over the diseased areas, the bark of which eventually cracks and falls away from the dead, discoloured wood.

The fruit on diseased trees is affected by an irregular, roughened, corky growth at the lower end. It is not known whether this is caused by the same organism as that on the branches, but it resembles that described by Stevens (*Proc. Florida State Hort. Soc.*, 1918) and is stated to be due to a *Gloeosporium* or closely allied species.

Perithecia occur on the stem lesions, but were not produced in culture; they contain 8-spored asci and paraphyses, the ascospores being 20 to 21 by 8 to 10 μ, and tapering abruptly at each end to a blunt apex. Pycnidia are found both on the stems and in culture; in the latter case they develop in sclerotia up to 6 mm. in diameter which bear numerous pycnidia at the top, filled with hyaline, elliptical conidia, 18 to 20 by 5 to 6 μ in diameter. The fungus is a *Physalospora*, to which the name *P. perseae* n. sp. is given, a Latin diagnosis being furnished.

Inoculations with conidia from cultures gave successful results on seedling avocados when the bark was wounded. In two cases the tree was killed by girdling of the stem, and typical pycnidia were produced in six months.

The mycelium penetrates the cortical tissues and reaches the wood, where it is apparently confined to the medullary rays.

The disease can probably be arrested in its early stages by excising all diseased twigs and stem cankers, and painting the wounds with a disinfectant wound dressing.

Barss (H. P.). **Peach tree protection a duty.**—*Seventeenth Biennial Rept. Oregon Board of Hort.*, pp. 159–161, 1 fig., 1923.

Peach blight [*Coryneum beijerinckii*] may be effectively controlled in Oregon by the application, before the beginning of the autumn rains, of Bordeaux mixture 6–6–50. Where the disease has gained a very strong hold in the orchard, spring spraying with self-boiled lime-sulphur is advisable for a year or two.

Leaf curl [*Exoascus deformans*] may be controlled by the application of Bordeaux mixture at any date between December 1 and the second or third week in February.

Very good results have frequently been obtained with lime-sulphur instead of Bordeaux, but, probably owing to the low temperatures in autumn and winter in Oregon, the former is not so reliable in its effects as the latter.

Fryer (P. J.). **Successful spraying and how to achieve it.**—152 pp., 81 figs. London, Ernest Benn, Ltd., 1923.

This book is concerned primarily with the practical and economic aspect of spraying for the control of plant pests and diseases in the orchard. It contains much useful information on the correct type of remedy to use in given instances, the elementary chemistry of spraying, the question of the water supply, methods of application, and brief descriptions of the principal insect and fungous diseases of fruit, with appropriate treatments for each.

Capus (J.). **Les conditions d'action de bouillies cupriques contre le mildiou.** [Conditions for the efficacy of copper solutions against mildew.]—*Comptes Rendus Acad. Agric. de France*, ix, 20, pp. 543–548, 1923.

The conditions under which copper fungicides are effective in controlling the downy mildew of the vine (*Plasmopara viticola*) are discussed and instances are quoted to show that spraying must be carried out before the germ-tubes of the parasite have entered the leaf. During the incubation period, which may last from 5 to 28 days according to the weather, spraying does not check the progress of the fungus in the tissues. On the other hand, any copper fungicide which remains active during the period of germination of the spores will control the most severe attacks of mildew.

Spraying immediately after a fall of rain during which the spores have begun to germinate may be quite as effective as that given before the rain, provided only that the germ-tubes have not had time to penetrate into the tissues.

The suggestion is made that since enzymes are known to be inactivated by minute traces of certain metals, the efficacy of copper fungicides applied prior to or during germination depends not on their toxic action on the sporangia or zoospores, but on inhibition of the enzymes secreted by the germ-tubes which aid the latter to penetrate into the tissues of the host plant.

Sorauer (P.). **Handbuch der Pflanzenkrankheiten, vierte Auflage, Bd. III, Die pflanzlichen Parasiten, zweiter Teil.** [Handbook of plant diseases, 4th Ed., Vol. III, The Vegetable Parasites, Pt. 2.]—310 pp., 55 figs. Berlin, Paul Parey, 1923.

The appearance of this part of the 4th edition of Sorauer's well-known handbook marks the completion of the section dealing with diseases caused by bacteria and fungi. That dealing with non-parasitic diseases has already been published, while the two volumes concerning the animal parasites of plants are in the press.

The general scope of the work is too well known to require discussion. The new edition has been prepared under the direction of Graebner, Lindau, and Reh, and their collaborators in the present volume are Köhler, Laubert, Wollenweber, and Zillig. The treatment follows the lines of the previous edition, but a considerable amount of new matter has been added. Of particular interest are the sections dealing with diseases caused by species of the genus *Fusarium* by Wollenweber, on the smuts by Zillig, and on the general principles of treatment (including the production of resistant varieties of crop plants) by Köhler. While special prominence is given to the work of German investigators, there are numerous references to foreign publications dealing with the diseases discussed in the present volume.

Bewley (W. F.). **Diseases of glasshouse plants.**—195 pp., 47 figs., London, Ernest Benn, Ltd., 1923.

The present volume combines the accumulated and extensive empirical knowledge of their plants in health and disease possessed by the growers in the highly specialized market garden glasshouse industry of the Lea Valley, from which London draws a large proportion of its supply of tomatoes, cucumbers, and the like, with the results of the author's scientific investigations at the Cheshunt Experimental and Research Station, of which he is Director.

Under the heading 'Hygienic conditions of glasshouses', such factors as situation, atmosphere, watering, and the sources of infection of plant disease are briefly and clearly discussed. Physiological diseases, represented by malnutrition, chlorosis, gas injury, and affections of unknown origin, are described, together with an account of predisposing atmospheric and nutritional factors.

Various well-known diseases of economic importance, many of which have been elucidated in the author's previous publications, on tomatoes, cucumbers, melons, and flowering plants and bulbs are admirably described and figured in the chapters on fungous, bacterial, and mosaic diseases. The work concludes with practical directions for soil sterilization, spraying and dusting, breeding, hybridization, and other aspects of control.

A list of tomato diseases found in England and a bibliography of 51 titles are appended.

Da Cunha (A. M.) & Muniz (J.). **Parasitismo de 'Trichomonas' por 'Chytridiaceae' do genero 'Sphaerita' Dangeard.** [Parasitism of *Trichomonas* by Chytridiaceae of the genus *Sphaerita* Dangeard.]—*Brazil Medico*, 13th Jan., 1923. [Abs. in *Bull. Inst. Pasteur*, xxi, 19, p. 755, 1923.]

Structures resembling Chytridiaceous sporangia have been found

in Brazil in several species of *Trichomonas* (*T. muris*, *T. gallinarum*, and the species occurring in 'anu branco', an indigenous bird).

A new species, *Sphaerita minor* da Cunha & Muniz, based on these, has been created.

OTA (M.). **Sur une nouvelle espèce d'Aspergillus pathogène: Aspergillus jeanselmei n. sp.** [On a new pathogenic species of *Aspergillus*: *Aspergillus jeanselmei* n. sp.]—*Ann. Parasitol. Humaine et Comp.*, I, 2, pp. 137–146, 5 figs., 1923.

The principal causes of onychomycosis are species of *Achorion* and *Trichophyton*, but other fungi have also been met with in affections of the nails, such as yeasts, species of *Penicillium* (or *Scopulariopsis*), *Spicaria*, *Sterigmatocystis*, and a species of *Aspergillus*.

A new species of the latter genus was discovered by the author in the finger nails of a hospital patient in Paris. It was not possible to determine whether the organism was the primary cause of the nail disease or whether its action was secondary, but the author inclines to the latter view. It was, however, proved to be capable of invading the nails and to be pathogenic to animals under laboratory conditions. In all only four fingers of the patient had retained their nails, which were deformed, thickened, and of a yellowish-grey colour with a waxy sheen; the others had thick crusts instead of nails. The white mycelium growing in these had hyphae about 5 μ broad which were closely septate, the lateral branches being composed of short, not very numerous cells. The spherical, or sometimes ovoid, conidia found in the nails were attached to the tips of the conidiophores in a manner resembling that of species of *Penicillium* and *Oidium* rather than *Aspergillus*, and at first the case was believed to be one of infection by *Penicillium brevicaule*. The cultural and morphological characters of the fungus, however, placed it definitely with the *Aspergilli*. The phialids (sterigmata) may be simple or branched, and are therefore of the *Sterigmatocystis* type.

The cultural characters of the fungus, which is named *Aspergillus jeanselmei* n. sp., are described. Growth appears to be favoured by very nutritious media, humidity, and a fairly high temperature (35° to 40° C.). On dry media conidiophores of the *Penicillium* type are produced. Perithecia have not developed in any of the media employed.

SARTORY (A.), PIÉCHAUD (F.), & RUDEAU (C.). **Angine chronique due à un Oospora et à une levure.** [Chronic angina due to an *Oospora* and a yeast.]—*Comptes Rendus Soc. de Biol.*, lxxxix, 19, pp. 43–45, 1923.

In February 1922 a fungus and a yeast were isolated from the tonsils of a young female patient suffering from asthenia and slight discomfort in the region of the pharynx. The symptoms yielded to treatment with iodine. Six months previously the patient had unpicked two cushions filled with oat chaff which had a strong odour of fermentation.

Cultures of the fungus on maltose showed the following

characters: hyphae of variable length, often 0·7 to 0·8 μ in width, generally straight, becoming sinuous and wavy later; lateral ramifications irregularly distributed; fructifications appearing in concatenate groups about the 14th or 15th day. The morphological, cultural, and biological characters corresponded with those of *Oospora* [*Nocardia*] *buccalis*.

The yeast developed luxuriantly on carrot at a temperature of 32° to 35° C. Its characters on carrot and other media are briefly described. Milk was coagulated from the tenth day onwards, with precipitation of casein. It was identified as *Cryptococcus rogeri* and found to be pathogenic to the guinea-pig and rabbit. When these animals were inoculated with mixed cultures of *C. rogeri* and *O. buccalis*, the symptoms were more severe than those occurring after inoculation with one of the organisms only.

TWORT (F. W.). **The ultramicroscopic viruses.**—*Journ. State Med.*, xxxi, 8, pp. 351–366, 1923.

In this paper the author gives a further hypothetical discussion of the nature of ultramicroscopic viruses [see this *Review*, i, p. 439].

A relationship with ordinary bacteria is not thought probable for many reasons, amongst which are the differences in cell reaction to infection, in immunity reactions, and in the tolerance of high concentrations of glycerine.

Assuming the existence of pre-cellular forms of life, there appears to be no argument against the possibility that some at least of the ultramicroscopic viruses are representative of this stage, being pathogenic to the cell in the same way that an amoeba is pathogenic to an animal.

Another possibility which deserves consideration is that the ultramicroscopic viruses may be molecules of the multimolecular, specialized organization known as a cell, which for some reason, in the early division of the fertilized cell, never developed beyond the stage of separate existence. It is possible that the formation of cancer cells may be due to the partial reversion of one or more of their protoplasmic molecules to the independent life of a unimolecular, pre-cellular ancestor.

Another possible explanation is that, under some stimulus, a cell will produce a special molecule containing or consisting of an enzyme, which, through some adverse external condition, becomes abnormal and pathological in its action. A virus originating in this way could be transmitted to a fresh host of the same species, and disease of this type might also arise *de novo* at any time.

In 1915 the author showed by experiments with pure cultures of bacteria that a lytic substance constantly reappeared after repeated plating out, and that, when once obtained, this lysin could be transmitted through an indefinite number of growths of the micro-organisms, causing their dissolution into granules. There is thus a certain resemblance between the character of these lysins and that of the ultramicroscopic viruses.

The absence of staining and visibility can easily be accounted for if it is assumed that the viruses belong to the unimolecular stage of organization.

WOLFF (J.). **Contribution à la connaissance des phénomènes de symbiose chez les Orchidées.** [Contribution to the knowledge of the phenomena of symbiosis in Orchideae.]—*Comptes Rendus Acad. des Sciences*, clxxvii, 13, pp. 554–555, 1923.

The lack of agreement between Bernard's experiments on the one hand and those of Burgeff, Lamy, and himself on the other, leads the author to believe that Bernard, in holding that the mycelium of the endophytic fungi of the Orchideae loses in time its power of adaptation to symbiosis, did not sufficiently take into account the probability that the age and origin of the orchid seeds may have an influence on their germination in the presence of the symbiotic fungus. He is supported in this view by the fact that, in a number of germination tests made by him with orchid seeds of varying age, he observed that the rapidity and percentage of germination quickly diminished with the age of the seed, no germination at all occurring in seed over 3 months old. On the other hand, mycelium 30 days old, and passed through several cultures, reacted as well as fresh mycelium, and mycelium 3 months old gave excellent results with young seed.

BONDARTZEFF (A. S.). **Антракноз пальм—Gloeosporium palmarum Oud.** [Anthracnose of Palms—*Gloeosporium palmarum* Oud.]—'*Plant diseases*', *Journ. Centr. Phytopath. Stat. Chief Bot. Gard. Russian Republic*, xi, pp. 1–2, 1922.

Gloeosporium palmarum Oudemans was found heavily attacking a large number of plants of various species of ornamental palms in the damp hothouses of the Botanical Garden in Petrograd. The infection usually starts from the base of weak, dying leaves, or from the remains of the sheaths of younger leaves in the crown, and, if not checked, the fungus finally spreads to vigorous, healthy leaves and eventually kills the plant. A brief description is given of the symptoms of the disease and the morphology of the fungus. Measures for controlling attacks in the greenhouses should consist in keeping the plants in drier and less crowded conditions, in removing and destroying the heavily infected portions of the plants, and in washing the leaves with a solution of 'green soap' once or twice in the week; the latter measure is often effective in curing the diseased palms in 3 to 4 weeks.

CHAUZIT (J.). **Maladies de la Pomme de terre: moyens de les combattre.** [Potato diseases: methods of control.]—*Prog. Agric. et Vitic.*, xl, 28, pp. 63–71; 29, pp. 89–95; 30, pp. 115–118; 31, pp. 136–141, 1923.

In this series of papers the author describes some of the commoner diseases of the potato in France, namely, *Phytophthora infestans*, *Bacillus melanogenes* [*B. atrosepticus*], *Verticillium alboatrum*, *Alternaria solani*, *Rhizoctonia* [*solani*], *Sclerotinia libertiana*, *Actinomyces* [*scabies*], *Spongospora* [*subterranea*], *Oidium*, streak, leaf roll, mosaic, crinkle, and 'filosité'. In each case appropriate curative and preventive measures are indicated.

Only three of these diseases can be controlled satisfactorily by external treatments, *Phytophthora infestans* and *Alternaria solani* by spraying, and *Rhizoctonia* by disinfecting the seed tubers with

formalin. In the other cases direct action against the parasites is not considered possible. Great stress, therefore, is laid on selection as a means of control of hereditary (especially virus) diseases. In a number of districts in France this is carried out to some extent, but in most cases the methods employed are based on wrong principles or otherwise inadequate. Individual selection is the practice which, in the author's opinion, has given the best results. The principle of this method is to locate in the field the most healthy individuals and to breed from them in separate plots, where the most rigorous rejection of all groups in which a single diseased plant appears takes place. The method is discussed in great detail and it is recommended to leave a space of 4 to 10 metres between the groups, while the trial plots are to be kept as far as possible away from the actual potato fields.

Each variety prefers a particular kind of soil and shows more or less resistance to 'degeneration' according to the nature of the soil on which it is grown. There are highly productive soils in which 'degeneration' rapidly sets in, whilst there are other fields in which the plants keep perfectly healthy although the yield is low. In the selection programme, the selected potatoes must be tried on various kinds of soil and in different localities. This is the method employed by the Dutch, and it is the only one which is considered to afford information on the regions and the soils which suit a selected variety and those which permit the varieties to retain their health.

Selected potatoes must also be tested for their resistance to infection by planting diseased tubers in their midst and testing the progeny for disease.

In order to realize this programme State intervention is recommended. The author describes in detail the method adopted by the Agricultural Office of Eure-et-Loir, under which fields are inspected and certificates issued indicating the condition of the seed.

Ducomet (V.) & Foëx (E.). **Les principales maladies de la Pomme de terre : Les moyens de les prévenir.** [The principal Potato diseases : the means of prevention.]—16 pp., 5 col. pl. Librairie Agricole de la 'Maison Rustique', Paris, 1923.

This pamphlet, published under the auspices of the French Ministry of Agriculture, describes the principal diseases of the potato in France [see also preceding abstract], with especial regard to the so-called degeneration diseases, and their treatment.

In a preface the presidents of the regional 'Agricultural Offices' state that in France there are 1,500,000 hectares [3,700,000 acres] under potato cultivation, which produce on an average 130 million quintals [nearly 6 million tons] of potatoes per annum. The degeneration diseases, 'frisolée', leaf roll, and mosaic, which have caused enormous losses, are incurable, and the only way to eradicate them is by rigorous selection, of which several methods are described in detail.

Fourteen other diseases of the potato, grouped under foliage, stem, and tuber diseases, are briefly described and means for their prevention or cure indicated. A chapter is devoted to the methods

of storing tubers either in cellars or in pits, for consumption or for seed, and another to the preparation of seed tubers for planting.

MÜLLER (K. O.). **Ueber parasitäre Erkrankungen der Kartoffelblüte.** [On parasitic diseases of the Potato flower.]—*Arb. Biol. Reichsanst. für Land- und Forstwirtsch.*, xi, 4, pp. 316–320, 2 figs., 1923.

The process of hybridization of the potato is frequently impeded by infection of the flowers by parasitic fungi. The results of isolalation experiments carried out on forty flowers in hot, dry weather showed that *Alternaria solani*, with or without *Penicillium glaucum*, was the most frequent cause of disease. *P. glaucum* alone, *Mucor mucedo*, and a species of *Botrytis* also occurred in a few instances. Infection took place chiefly through the unwounded stigma and, to some extent, through the wounded style. Both *A. solani* and *P. glaucum* prevented the setting of fruit if infection took place 24 hours before pollination, or if it exactly coincided with the opening of the flower.

In damp weather *Phytophthora infestans* and *M. mucedo* attacked all parts of both flower and berry and rapidly destroyed them.

SCHANDER (R.) & RICHTER (K.). **Untersuchungen über das Verhältnis der Keimfähigkeit der Kartoffelknollen zum Gesundheitszustand und Ertrag.** [Investigations on the relation of the germination activity of Potato tubers to healthiness and yield.]—*Centralbl. für Bakt.*, Abt. 2, lx, 1–6, pp. 27–50, 8 graphs, 1923.

The purpose of the author's work, carried out in 1921–1922 at Landsberg a.W., was to endeavour to ascertain whether germination tests of potato tubers, taken from representative samples of large seed lots, could be used for forecasting the health and yield of the plants arising from the seed, and whether such tests could form a criterion for judging the value of new potato varieties and strains.

Details are given of the methods and technique employed in the experiments which, in 1922, included different strains of 25 named varieties of potato. From the point of view of diagnosing disease, both sterilized earth and sterilized sand (the latter either dry or wetted with 0·4 per cent. in weight of sterilized water) proved to be equally good germination media, while free-air germination, either in darkness or in light, was found to be unsatisfactory, as it inhibits the development of *Rhizoctonia* and various bacterial rots which may be present in or on the tubers.

The following is a summary of the conclusions arrived at by the authors. There is a distinct correlation between the viability of the mother-tuber and the yield of the plant arising from it, the yields being directly proportional to the number of sprouts produced by the tuber. In healthy tubers, the number of sprouts produced is in direct but rather low proportion to the size of the tuber, the difference between medium and large-sized tubers being inconsiderable. Plants affected with leaf roll, in the authors' experiments, arose from tubers with a strongly reduced germinative

power; the more the latter was lowered, the more pronounced was the disease. In cases of mosaic and crinkle also the number of sprouts was greatly reduced, while the viability of the tuber was much less impaired in the few cases observed of 'Barbarossa' disease (this disease is stated to occur chiefly in red-skinned varieties; its outstanding symptom is the loss of the erect habit in the developing shoots, which have greatly shortened internodes and reduced leaves and spread on the ground). *Rhizoctonia solani* (*Hypochnus solani*) proved to be highly detrimental to the viability of the tubers by weakening or even destroying the 'eyes' and thus greatly reducing the number of green shoots produced. The germinative power of the tubers was not, as a general rule, impaired to any great extent by *Actinomyces* scab [*A. scabies*] or by fungous and bacterial rots; the latter two reduced the viability only when the lesions caused by them involved large portions of the tubers. Certain fungi (*Verticillium*, *Fusarium*) were found to reduce heavily the subsequent development of the plants when they succeeded in penetrating into the vessels of the germinating sprouts. A low germinative power is not by itself an indication of the presence of any disease in the tubers, as apparently quite healthy tubers may sometimes exhibit a depressed viability with resulting poor yields.

In the last part of the paper are given the rules adopted by the German Union of Agricultural Experiment Stations ('Verband landwirtschaftlicher Versuchsstationen') for taking representative samples from large seed lots, and also the lines on which such samples should be investigated for diseases and other injuries.

BOTJES (J. O.). **Het gebruik van onrijpe aardappelknollen als pootgoed.** [The use of unripe Potatoes for seed.]—*Cultura*, xxv, 9, pp. 1–9, 1923.

Healthy tubers of the potato variety Eigenheimer, which is very susceptible to mosaic diseases, were cut in four parts and planted in healthy surroundings in 1922, while other tubers of the same lots also were also cut in four parts and planted between two rows of mosaic diseased potatoes.

The hills produced by the different parts of all the tuber units were lifted at different dates, 13th July, 21st July, and 26th September 1922. In 1923 there was no difference in the state of health of the progeny of immature and mature seed from the tuber units which in 1922 were growing in healthy surroundings. On the other hand the progeny of the hills growing between two rows of mosaic diseased plants in 1922 showed in 1923 4·4 per cent. mosaic diseased hills from the seed that was lifted on 13th July, 10 per cent. from the seed that was lifted on 21st July, and 68 per cent. from the seed that was lifted on 26th September 1922.

A similar experiment was made with regard to leaf roll. The progeny of tuber units of the variety Paul Kruger [President] growing in 1922 between two rows of leaf roll diseased potatoes, in 1923 showed 0 per cent. leaf roll diseased plants when the seed was lifted on 19th July 1922, 19 per cent. when lifted on 5th August, 96 per cent. when lifted on 27th September, and 80 per

cent. when lifted on 10th October. The progeny of tuber units, which in 1922 were growing in healthy surroundings, did not show a difference of any importance in favour of the immature seed. The yield in this case was not increased by early lifting of the seed.

The author concludes that the increased yield from the use of unripe seed is a consequence of the protection against tuber infection by an early interruption of the communication between tubers and foliage. When infection is not liable to occur, immature seed is not better than mature seed.

BAUCH (R.). **Ueber Ustilago longissima und ihre Varietät Macrospora.** [On *Ustilago longissima* and its variety *macrospora.*]—*Zeitschr. für Bot.*, xv, 5, pp. 241–279, 1 pl., 6 figs., 1923.

The present investigation deals with the life-cycle of *Ustilago longissima* and its variety *macrospora,* which differ in the size of their spores and also in the mode of germination. The former germinates by giving a large number of sporidia from a small sterigma, without the formation of a promycelium, the sporidia germinating into a mycelium-like pluricellular structure (the 'carpophore') which again bears sporidia. The variety *macrospora* produces sporidia which immediately bud off secondary sporidia, without the intervention of a 'carpophore'. In starved cultures, however, the latter variety often germinates in a manner similar to that of *U. violacea.*

In both forms the reduction division of the nucleus occurs on germination of the diploid smut spore. In *macrospora* two nuclei pass into the first-formed sporidium. These are usually of different sex, so that conjugation can occur between the secondary sporidia. The binuclear first sporidium is bicellular, whilst the later sporidia always contain one nucleus only and are unicellular. In *U. longissima* the first two sporidia are binuclear, while those subsequently formed are uninuclear; no obvious differentiation exists between the sporidia, since all of them develop into 'carpophores'.

The subsequent binuclear stage arises in both varieties through conjugation of the sporidia or, in the *macrospora* variety, also through conjugation of the two cells of the first sporidium. Under the influence of certain cultural conditions the binuclear condition can break up again into its haploid components. Both conjugating partners participate actively in the process of conjugation by each giving rise to a conjugation-tube.

U. longissima was found to exhibit a divergence from the normal form of heterothallism in that it has three kinds of sporidia differing from each other by their sexual characteristics. Each of these can conjugate with either of the other two.

KIRCHNER (O.). **Der Antherenbrand von Salvia, Ustilago betonicae Beck.** [The anther smut of *Salvia, Ustilago betonicae* Beck.]—*Zeitschr. für Pflanzenkrankh.*, xxxiii, 3–4, pp. 97–104, 3 figs., 1923.

The rare anther smut of *Salvia* was found by the author near

Stuttgart and in the Tyrol in 1909. It was previously collected in Italy in 1860 and named by Ferraris in 1902 *Ustilago violacea* f. *salviae*.

Subsequent observations by the author indicated that the smut persists from year to year in the host plant and can also spread to other plants in the neighbourhood. Its spores are 11 to 18 μ in diameter, round, oval, or angular, marked with a distinct network, and dark purple in colour. These characters distinguish it from *U. violacea*, but it resembles so closely *U. betonica*, the anther smut of *Betonica alopecurus*, that the author identifies the *Salvia* fungus with the latter.

Infection through the flowers, as occurs in *U. violacea*, is stated to be precluded by the rapid fall of the corolla, stamens, and style. Attempts to secure seedling infection failed. Germination of the spores is scanty and difficult to induce.

KILLIAN (C.) & LIKUITÉ (V.). **Le développement du Hendersonia foliorum Fcl.** [The development of *Hendersonia foliorum* Fcl.]—*Comptes Rendus Acad. des Sciences*, clxxvii, 9, pp. 484–486, 1 fig., 1923.

The authors claim to have found an ascigerous stage in the life-cycle of *Hendersonia foliorum* Fcl (a frequent parasite on the leaves of *Salix capraea*) which, they state, was hitherto unknown.

The mycelium forms plectenchymatous masses in the tissues of the host, in each of which a central cavity filled with conidia develops, the conidia being liberated by the rupture of the pycnidial wall. After this the perithecia develop from the same mycelium. The figures show a flask-shaped perithecium, with club-shaped asci and paraphyses. The 8 ascospores are uniseriate, elliptical, and bicellular, but as they mature they become elongated, slightly curved, and further divided.

Cytological details are given of the development of the asci and ascospores. The fungus is considered to belong cytologically to the series of *Cudonia*, *Melanospora*, *Lachnea*, and *Ascobolus*, and to be most closely related to the latter. In *Hendersonia* there no longer exists any trace of sexuality, the only indication of which that is found in *Ascobolus*, namely, the presence of pores between the sub-terminal cells, having been lost.

HÖHNEL (F. v.). **Studien über Hyphomyzeten.** [Studies on Hyphomycetes.]—*Centralbl. für Bakt.*, Abt. 2, lx, 1–6, pp. 1–26, 1923.

This paper has been prepared by Weese from writings left unpublished by the author at the time of his death.

An attempt is made to define more closely the two genera *Passalora* and *Fusicladium*. *Passalora* is regarded as consisting only of conidial forms belonging to the genus *Carlia* (= *Mycosphaerella*), the conidial stage being exactly the same as in *Cercospora* except that the conidia are shorter, obclavate-fusiform, coloured, and bicellular. To this genus belong *Fusicladium heterosporum* Höhn., *F. depressum* B. & Br. (with perfect stage *Carlia angelicae* (Fr.) Höhn.), and *F. punctiforme* Wint. (= *Cercospora platyspora*

Ell. & Hollw. = *C. sii* Ell. & Ev.). The last fungus is perhaps only a short-spored form of *Passalora depressa*.

Fusicladium is the imperfect stage of *Venturia*, and has straight conidiophores which emerge through the cuticle and bear a single conidium at the tip, unlike *Passalora* where the conidiophores emerge from the stomata, are bent or knobby, and bear several conidia in succession. In *Fusicladium* the mycelium is subcuticular (though at a later stage it may penetrate more deeply into the tissues) and radially developed. *Fusicladium aronici* Sacc. (= *F. schnablianum* Allesch. = *Scolicotrichum cardui* Schroet.) has almost spirally twisted conidiophores emerging through the cuticle from a mycelium which is neither subcuticular nor radially developed, and each bears a single conidium. It is made the type of a new genus *Fusicladiella*, and has as pycnidial stages *Stictochorella personatae* (Allesch.) Höhn. (= *Phyllosticta personatae* Allesch.) and *Septoria* (= *Phyllosticta aronici* Sacc.). The perfect stage of this fungus has been found by the author in an unripe condition and is of the Phyllachoraceous type. The same fungus was described from mature specimens as *Mycosphaerella aronici* by Volkart, and is evidently, when weakly developed, a *Carlia* (= *Mycosphaerella*) almost devoid of stroma, whereas when more strongly developed it has a distinct Phyllachoroid stroma. *Fusicladium fasciculatum* C. et E. is a *Cercosporidium* resembling *Passalora* but with 2- to 4-cellular, hyaline, or subhyaline conidia. *F. caricinum* Bres. is probably a *Heterosporium*. *F. caricae* (Speg.) Sacc. belongs to the Tuberculariaceae and can be placed provisionally in the genus *Pucciniopsis*. *F. vanillae* Zimm. is a *Didymothamium*. *F. kaki* Hori and Yosh. is the type of a new genus *Hormocladium*, with 1- or 2-celled conidia in chains on short conidiophores emerging through the stomata. *F. transversum* Sacc. is a *Cladosporium*-like fungus, approaching *Heterosporium*. *Fusicladium eriobotryae* Cav. is a true *Fusicladium*, but is regarded as only a form of *F. dendriticum*.

The genus *Scolicotrichum* Kze is based on the type *S. virescens* Kze; but this fungus is of a very doubtful character and the species referred to the genus are in many cases unconnected therewith. *S. graminis* Fcl is a *Passalora* with perfect stage *Carlia recutita* (= *Sphaeria recutita* Fr. = *Metasphaeria recutita* (Fr.) Sacc.). *Azosma punctum* Lacroix is not this fungus, as stated by some authors, but is *Passalora depressa*. *Scolicotrichum compressum* Allesch., *Passalora hordei* Otth., and *P. punctiformis* Otth. are all identical with *Passalora graminis* (Fcl) Höhn. *S. fraxini* Pass. is a *Pucciniopsis*; *S. iridis* Faut. & Roum. is *Heterosporium gracile*; *S. musae* Zimm. is a typical *Cordana*; *S. asclepiades* is a *Passalora* with dark brown conidia; *S. maculicola* Ell. & Kell. is a *Cladosporium*, probably identical with *C. phragmitis* Opiz; *S. melophthorum* Prill. & Del. is a typical *Cladosporium*, and the same as *C. cucumerinum* Ell. & Arth.; *S. cladosporioideum* Maire is *Heterosporium gracile* Sacc., as is also *H. montenegrinum* Bub.; *S. roumegueri* Cav. is *Napicladium arundinaceum* (Cda) Sacc. (= *Hadrotrichum phragmitis* Fcl as recognized by Saccardo, = *Napicladium laxum* Bub.), and is allied to *Cycloconium* Cast., a genus differing from *Fusicladium* chiefly in the strictly

subcuticular development of radially directed hyphae which are not united into strands; *S. clavarium* (Desm.) Sacc. is a *Cladotrichum*.

Triposporium bicorne Morgan is made the type of a new genus, *Ceratosporella*, while *Torula canceratica* Strasser is identical with *T. conglutinata* Cda.

Notes are also given on several other genera of the Hyphomycetes including *Graphium* Cda. *Coccosporella* Karst. (identical with *Mycogone* Link), and *Papulaspora* Preuss. Several new genera and species are described, mostly saprophytes. *Eidamia* Lindau is stated to be a synonym of *Harzia* Cost., the latter genus being created to contain *Monosporium acremonoides* Harz, which is only a form without bulbils of *Papulaspora sepedonioides* Preuss. (= *P. aspergilliformis* Eidam = *Helicosporangium parasiticum* Karst.). Neger has found a *Papulaspora*, possibly *P. sepedonioides*, to be a conidial form of *Melanospora marchica* Lindau.

Notes on several species of *Ramularia* and other genera are also given.

BEELI (M.). **Notes mycologiques. I. Contributions à la flore mycologique du Congo.**—*Bull. Jard. Bot. de l'État (Bruxelles)*, viii, 1, pp. 1–22, 1 pl., 1922. [Received 1923.]

Part I records new determinations of fungi for the Congo. Nine new species, mostly parasitic, are described: *Schizothyrium congoensis* on *Rottboellia*, *Micropeltis congoensis* on numerous hosts, *M. wildemani* and *M. dubia* on unidentified leguminous hosts, *Triphragmium graminicola* on a grass, *Ustilago hyparrheniae* on *Hyparrhenia diplandra*, *Sorosporium chloridicola* on *Chloris polydactyla*, *S. aristidae-amplissimae* on *A. amplissimus*, and *S. panici* on *Panicum* sp. Five new varieties are also described.

Part II is a list of the Ustilagineae recorded for the Congo, with their hosts, spore measurements, and the authority for the record; and Part III a list of African Ustilagineae arranged by hosts, each with its reference in Saccardo's *Sylloge*.

SHEAR (C. L.). **Life histories and undescribed genera and species of fungi.**—*Mycologia*, xv, 3, pp. 120–131, 2 pl., 7 figs., 1923.

The following reference of interest to phytopathologists is contained in this paper.

Phyllostictina carpogena n. sp. occurs on the vines and berries of the dewberry [*Rubus caesius*] causing a rot. The genus *Phyllostictina* should, in the author's opinion, be restricted to pycnidial forms of the genus *Guignardia*. The present fungus has the same structure as the pycnidial stage of *G. bidwellii* on the grape. *Phyllostictina vaccinii* comb. nov. is the pycnidial form of *Guignardia vaccinii*. Other species that should be transferred to this genus are *Phyllosticta solitaria* [the cause of apple blotch], and *P. congesta* [the cause of plum blotch].

TUNSTALL (A. C.). **A first aid set for diseased Tea.**—*Quart. Journ. Indian Tea Assoc.*, i, pp. 16–19, 1923.

In view of the fact that fungous diseases of tea, such as blister blight [*Exobasidium vexans*], frequently appear on an epidemic scale at a moment's notice, it is absolutely essential for all tea

gardens to be provided with an emergency set of spraying requisites in order to cope rapidly with an outbreak. The minimum amount of apparatus kept in stock should comprise 6 sprayers complete with nozzles (this should suffice for spraying three or four acres per day); 6 sets of spare parts; 6 spare nozzles; 1 set of tools; 6 forty-gallon barrels; 12 kerosene tins fitted with wooden handles and painted; 1 hand-cart fitted to carry sprayers and spares; 1 hand-cart to transport barrels. Sufficient materials should be available to prepare 27,000 galls., preferably of lime-sulphur, namely, $13\frac{1}{2}$ maunds [1 maund = roughly 80 lb.] quicklime and 15 maunds sulphur. One sprayer can distribute about 150 galls. of spray fluid a day, and as 30 days may elapse, under Indian conditions, before fresh supplies can be obtained, it is necessary to be provided with enough material for the 6 sprayers during that period. In addition to this minimum outfit, each 100 acres above 600 should also have 1 sprayer complete, 1 set of spares, 1 spare nozzle, 1 barrel, and 2 kerosene tins, together with 180 lb. quicklime and $202\frac{1}{2}$ lb. sulphur.

ANDERSON (P. J.) & CHAPMAN (G. H.). **Tobacco wildfire in 1922.**—*Mass. Agric. Exper. Stat. Bull.* 213, 27 pp., 1 fig., 1923.

Tobacco wildfire (*Bacterium tabacum*) effected quite as much damage in the Connecticut Valley in 1922 as in 1921. Infection was first recorded on 7th May, and continuous rains and cloudy weather during the seed-bed period furnished ideal conditions for the spread of the disease: by 4th July it was raging in half the fields in the valley, the Broadleaf variety being much more seriously affected than in 1921. Subsequently the disease was arrested by hot, clear, and fairly fine weather, but later on rain-storms increased in frequency and continued until the crop was harvested. On the whole about 90 per cent. of the tobacco fields in the valley were affected, some being so severely 'fired' that not a single clean plant could be found. The prices received for such crops were estimated to be only a fraction of the cost of growing. Other states seriously affected in 1922 were New Hampshire, Vermont, Wisconsin, Pennsylvania, Maryland, Kentucky, Ohio, New York, and Georgia (the two last-named for the first time), but no loss occurred in Virginia and North Carolina, from which states the disease was first reported five years ago.

During the winter of 1921–22 experiments were conducted to determine the methods of overwintering of the bacteria. Pure cultures on agar were placed out-of-doors at various times, some being frozen solid for months. When brought back to the laboratory and transferred to other media they grew normally. There is as yet no experimental evidence in Connecticut in support of the hypothesis that the bacteria overwinter on the seed. In a number of experiments conducted by the authors all attempts to isolate the organism from suspected seed failed. Suspected seed was planted and no wildfire appeared on the seedlings where other sources of infection were eliminated. Seed inoculated by soaking in a pure culture of the bacteria and kept in a dry room all the winter produced clean plants in the spring. In another test, however, the seed was artificially inoculated after it had been

sterilized by heat. It remained wet from the culture for a fortnight. In the spring it was sprinkled on healthy leaves and wildfire resulted.

Although lesions have not been recorded on the seed, they are found on the calyx of the flower and on the seed-pod. If the bacteria do overwinter with the seed, it is probably in the fragments of pods, &c., which remain with the seed as chaff after threshing. It is unlikely, however, that any considerable proportion of the spring infection in the Connecticut Valley starts from the seed.

Laboratory data and field observations indicate that *Bact. tabacum* is able in some cases to survive the winter in the soil and start new infections from this source in the spring. On the other hand, it is apparently possible under certain conditions to raise a clean crop of tobacco on a field that has borne diseased crops during preceding years.

Further tests proved conclusively that the wildfire organism can overwinter on diseased cured leaves. The latter were ground to powder and sprinkled on wet plants in the greenhouse: these plants developed wildfire lesions in a fortnight. Cultures of wildfire bacteria were also obtained from cured leaves until the middle of March. So far, however, there is no evidence that the organism survives on leaves left in the field under Connecticut conditions.

Leaf stalks have not previously been reported to be attacked, but at South Amherst lesions were produced on the stalks, as white or light brown, depressed, inconspicuous spots, one-eighth to one-quarter of an inch in diameter. The halo was indistinct in most cases. Pure cultures from the stalks were able to produce the typical symptoms of wildfire.

In 1921 the authors' investigations led them to believe that all field infection originated in the seed-bed. During 1922, however, numerous cases occurred in which the disease could not possibly be traced to the seed-bed, and it is thought that some method of long-distance dissemination, as yet undetermined, was at work.

Based on the authors' own experimental work, which is briefly summarized, the following control measures are recommended. Seed should be selected only from disease-free fields. The flower heads may be protected by bags. Old seed is less liable to be contaminated. Suspected seed should be soaked in a cheesecloth bag for 15 minutes in 1 in 1,000 corrosive sublimate. Seed-beds should be located only on healthy soil, which may, as a further precaution, be sterilized with steam at 100 lb. pressure for 30 minutes or with 1 in 50 formalin at the rate of $\frac{1}{2}$ gall. per sq. ft. Paths should also be sterilized. This operation should be carried out in the spring in preference to the autumn. Boards, sashes, cloth, and the like should be drenched with 1 in 50 formalin. The plants should be covered with copper-lime dust or Bordeaux mixture from the time they attain the size of a finger-nail until the planting out is completed. The leaves of the plants must be kept moist for as short a time as possible compatible with good development. Diseased and adjacent healthy plants should be destroyed by drenching with 1 in 10 formalin. No work should be carried out in an affected field while the leaves are wet. The

removal of slightly diseased leaves, at intervals of three or four days, may materially reduce the percentage of wildfire in the crop.

Palm (B. T.). **Verslag van het Deli Proefstation over 1 Juli 1922—30 Juni 1923.** [Report of the Deli Experiment Station for the period 1st July 1922 to 30th June 1923.]—*Meded. Deli Proefstat. te Medan-Sumatra*, Ser. 2, xxix, 41 pp., 1 pl., 1923.

Further investigations on the slime disease of tobacco [*Bacterium solanacearum*] have clearly demonstrated its connexion with the wild vegetation of the fields, and confirmed the excellent results already obtained by the use of the resistant *Mimosa invisa* [see this *Review*, ii, p. 295] as a green manure. The cultivation of this crop is stated to have gained a secure foothold in tobacco-planting circles, 6,000 kg. of *Mimosa* seed having been purchased during the period under review.

Slime disease has up to the present been found on upwards of a hundred plants, amongst the recent additions to the list being *Corchorus acutangulus*, *Ipomoea triloba*, *Lantana aculeata*, *L. trifolia*, and *Solanum torvum*.

Other tobacco diseases were also studied with special reference to their effect on the wild vegetation of the fields. It was found that *Ricinus communis* and *Commelina nudiflora* are susceptible, at any rate in the early stages of development, to the 'bibit' disease (*Phytophthora nicotianae*), which was shown by inoculation experiments to be readily transmissible also to tomatoes, but not to potatoes, and only under extremely humid conditions to *Trema amboinensis*.

Mosaic disease of tobacco was shown to be transmissible to Chile peppers (*Capsicum annuum* and *C. frutescens*), *Solanum torvum*, *S. ferox*, eggplant (*S. melongena*), tomato (*S. lycopersicum*), *Physalis angulata*, and *Cucurbita* sp.

A strain of *Sclerotium rolfsii*, which has hitherto formed sclerotia only once, was found on tobacco. The mycelium does not differ materially from that of normal strains, but occurs only in the form of loose tufts on the various media tried.

Palm (B. T.) **Bestrijding van plagen en ziekten in de Tabakscultur. Verslag van een studiereis in Europa en de Ver. Staaten.** [Control of pests and diseases in tobacco cultivation. Report of a voyage of investigation in Europe and the United States.]—*Meded. Deli Proefstat. te Medan-Sumatra*, Ser. 2, xxx, 54 pp., 6 pl., 1923.

From April to June 1922 the author, in his official capacity as Director of the Deli Experiment Station, visited the chief tobacco and cotton-growing centres of Europe and the United States, principally to study the application of up-to-date methods for the control of tobacco diseases and pests, while a secondary aim of the journey was to examine the machines used for the control of insect pests of cotton. The different types of spraying and dusting apparatus used in the United States are described, and their applicability to Dutch East Indian conditions discussed.

The present situation in America with regard to slime disease

[*Bacterium solanacearum*], root rot (*Thielavia basicola*), downy mildew [*Peronospora hyoscyami*], wildfire [*Bact. tabacum*], angular leaf spot [*Bact. angulatum*], and mosaic disease, is briefly outlined.

KLEBAHN (H.). **Infektionsversuche mit Taphrina tosquinetii.** [Infection experiments with *Taphrina tosquinetii.*]—*Ber. deutsch. Bot. Gesellsch.*, xli, 3, pp. 109–113, 5 figs., 1923.

Fragments of alder (*Alnus glutinosa*) leaves infected with *Taphrina tosquinetii* (Westend.) Magnus were placed in September 1919 in damp chambers over salep agar plates with the result that spores were almost immediately extruded and germinated on the agar by budding. On the following day the original clusters of 8 spores had each increased to from 20 to 60 or more. The 'yeast' conidia thus formed were smaller and more oval than the original spores. The cells appeared to separate immediately on formation but remained in close contiguity. There was no trace of a mycelium. The process of reproduction by budding was continued in cultures on sloped agar, on which a copious white film of conidia was gradually formed.

On 30th October 1919 a number of alder seedlings were inoculated at the buds with the conidia thus obtained, the operation being repeated in the following April. During the latter month symptoms of infection became apparent on 6 of the 45 inoculated trees. Further cases resulted from fresh inoculations of the buds in May and June. Only leaves which were still in bud or not more than ½ cm. in length at the time of inoculation became infected. Twenty-five plants in all were successfully inoculated up to June 1920. On 1st December 1920 twelve more seedlings were inoculated at the terminal and lateral buds, and in the following April nine showed the typical symptoms of infection, three only at the terminal buds, one at the lateral buds, and five at both. The operation was not repeated, but there was a fresh attack on the leaves of three of the trees in June.

On 2nd April 1921 fourteen fresh seedlings were inoculated, four of which became infected on 11th May. Of these one showed further symptoms on newly opened leaves in June and another in late July and the middle of August. Another seedling re-inoculated on 25th May became infected in June.

Observations were made in 1921 on some of the trees inoculated in 1919 and 1920. In some cases recently opened leaves were found to be infected while in others the trees remained healthy. It appears that under certain conditions, as yet undetermined, the fungus can overwinter in the plant, but how the perennial mycelium described by Sadebeck is formed, and how it passes from the twigs, under the cuticle of which it is said to occur, into the newly-developed buds, has not yet been ascertained.

Pure cultures of *T. epiphylla*, *T. sadebeckii*, *T. aurea*, and a species of *Taphrina* forming witches' brooms on *Betula pubescens* were obtained on agar, 'yeast' conidia being produced in every case. Inoculation experiments from these cultures gave negative results.

Leach (J.G.). **The parasitism of Colletotrichum lindemuthianum.** —*Minnesota Agric. Exper. Stat. Tech. Bull.* 14, 39 pp., 8 pl., 1 fig., 5 graphs, 1922. [Received 1923.]

As the result of comparative inoculation tests carried out from 1920 to 1922 with 15 cultures of *Colletotrichum lindemuthianum* from different localities on 14 varieties of field beans, at least eight distinct biologic forms of the fungus were found, an analytical key to which is given.

The size of the lesions produced on a susceptible bean plant inoculated with *C. lindemuthianum* was inversely proportional to the age of the tissue, but the latter had no effect in the case of highly resistant varieties.

The size of the spores of the fungus was influenced by the medium on which they were produced, different biologic forms, however, being differently affected by the same medium. These variations were sometimes equal to or greater than the difference in size of the spores of two forms on the same medium. Variations in spore dimensions are therefore considered to be of no practical significance.

The cardinal temperatures for the growth of *C. lindemuthianum* on agar plates are approximately: minimum 0° C., optimum 22·5° C., and maximum 32° to 34° C. The reaction to temperature was about the same for three of the biologic forms.

The common nutrient agars were of little use as differential media, modifications of Czapek's solution giving better results in this respect, especially when sucrose was replaced by xylose or mannitol. The fungus grew best in an alkaline medium, development being inhibited at a higher acid concentration than P_H 2·9. It developed well on Czapek's solution, the hydrogen-ion concentration of which was P_H 11·8 at the beginning of the experiment; at the end of two months there was a diminution in the alkalinity of this solution, probably due to the absorption of carbon dioxide from the air. The growth of the two biologic forms tested was generally similar at the various P_H values. There appeared to be a double optimum, both optima falling on the alkaline side.

All attempts to change the parasitic capabilities of a biologic form of *C. lindemuthianum*, and every effort to break down host resistance, met with negative results.

The spores of the fungus germinated poorly in distilled or tap water and in certain other solutions with or without nutrients. On the other hand, fresh bean tissue or juice stimulated germination to a remarkable degree, often producing positive chemotropism of the germ-tubes. The nature of the stimulus has not been ascertained. Green bean agar was also a useful medium for germination. The stimulation of germination was obtained only between P_H 3·4 and P_H 7.

The penetration of the epidermal cell wall is accomplished in the same way on susceptible and resistant varieties of beans. The spore, when germinating on the host, forms an appressorium which becomes attached to the cuticle by means of a mucilaginous sheath. A small infection hypha enters the epidermal cell, apparently by mechanical pressure. In young tissue of a susceptible variety the infection hypha enlarges into a normal mycelium

without immediately destroying the host protoplast. On reaching the inner cell wall resistance is encountered which retards apical growth and causes the enlargement and outward curving of the hypha, which becomes closely adpressed to the cell wall for about half its circumference. Penetration, in which mechanical pressure is thought to play an important part, finally takes place through a minute hole without any staining or swelling of the cell wall. The process continues through the cells of the cortex until about 100 hours after penetration, when the cell walls become softened throughout the infected region, begin to collapse, and stain brown.

In old tissue of susceptible varieties, the development of the mycelium is retarded by the increased resistance of the cell walls to penetration. The retarded mycelium disintegrates, destroying the host protoplast and staining the cell wall and cell contents reddish-brown.

The fungus grows equally well on the expressed juice of resistant and susceptible hosts.

Only one or two cells are generally attacked in a highly resistant variety, such as Ruby Horticultural Bush. The hyphae soon disintegrate, this process being accompanied by the death and disintegration of the host protoplast, and the reddish-brown discoloration of the entire cell contents and walls. In a less resistant variety more cells may be attacked, but the disintegration of the mycelium occurs sooner or later. This process is interpreted as a nutrition phenomenon, the mycelium being destroyed by autolysis induced by starvation, and the resulting products killing and staining the host cells.

Burkholder (W. H.). **The gamma strain of Colletotrichum lindemuthianum (Sacc. et Magn.) B. et C.**—*Phytopath.*, xiii, 7, pp. 316–323, 1923.

The inoculation experiments conducted in 1919 by Barrus with *Colletotrichum lindemuthianum* on 300 varieties of *Phaseolus vulgaris* and related species proved the existence of two distinct strains of the fungus, which were called 'alpha' and 'beta'. The great majority of the varieties of beans tested were susceptible to one or the other of the strains, while many reacted to both. Of the varieties immune from or resistant to both strains, the most important were Well's Red Kidney and the White Imperial, the former being immune from strain alpha and highly resistant to strain beta, and the latter (which is, however, a late variety and liable to succumb to early frosts) resistant to alpha and practically immune from beta.

In 1921 a field of beans said to be White Imperial was found to be severely affected with anthracnose. The author obtained a quantity of diseased seed from this field, which proved to be of the White Imperial type, and carried out an extensive series of tests with the fungus isolated from this seed.

The results of these experiments appear to indicate that the recently isolated fungus is a new strain of *C. lindemuthianum*, distinct from either alpha or beta but closely related to the latter. It is considered probable that it arose from the beta strain as a mutation. Its divergence from the latter is stated to be

sufficiently pronounced to justify the author in creating the new strain 'gamma', to which Well's Red Kidney and the White Imperial beans are susceptible.

ORTON (W. A.) & BEATTIE (R. K.). **The biological basis of foreign plant quarantines.**—*Phytopath.*, xiii, 7, pp. 295–306, 1923.

After a brief discussion of the losses caused by introduced diseases and pests and a summary of the principles on which the efforts to minimize these losses are based, the authors emphasize the necessity of distinguishing between the problem of the control of spread of a disease or pest within a given continuous land area and that of long-distance discontinuous spread, such as often occurs between different continents.

The biological considerations which have to be taken into account in dealing with the risk of dangerous introductions are discussed. Knowledge is required of the country where the parasite is endemic, its native or original host, the geographic distribution of this host, and its relationship to other economic plants in the country of introduction. A further important consideration is the extent to which a host, introduced without its parasites, has been altered by breeding so as to render it more susceptible to these parasites if subsequently introduced.

Various types of disturbance of biological equilibrium by the transfer of parasites from one plant zone to another are considered and illustrated by examples. A parasite introduced from one continental zone to another may find susceptible hosts in the latter (e. g. Asiatic chestnut bark disease in America, American vine diseases in Europe): or a plant carried from one continental zone to another may be attacked by new (local) parasites (the downy mildews of maize in south-eastern Asia): or a plant transferred without its parasites may be subsequently, after new and less resistant varieties have been evolved, followed by them (asparagus rust in America): or a domestic (local) parasite is limited in its natural geographical distribution by climatic factors, and the varieties of host cultivated in that area are more resistant than those introduced from areas in which the parasite is scarce or absent (black rot of grape vine in parts of America).

The plant zones in which organic life is in equilibrium are in the main continental. The plant relations of two or more contiguous countries, without a natural barrier, are different from those separated by ocean barriers. Within the former such measures as those envisaged by the Phytopathological Convention of Rome of 1914 may be useful, but these do not cover the relations between, say, North America and Europe or Asia.

In many cases the factors governing the spread of plant parasites require to be studied. The authors state that no case of long-distance transfer of plant disease by wind has been demonstrated, and that carriage of disease in ballast, except where soil is concerned, has not been definitely traced. The most frequent agent in such dissemination is man, and the outstanding medium of transfer is living plant material. Inspection and treatment of such imports are regarded as inadequate. Consequently intercontinental trade

in living plants is always attended by such grave risks that it should be held within the narrowest limits compatible with economic needs.

Amendments of the regulations for the control of wart disease in Scotland.—*Scottish Journ. Agric.*, vi, 3, pp. 333–335, 1923.

The Wart Disease of Potatoes (Scotland) Order of 1923, which took effect on 1st July and superseded the Order of 1918, was issued in view of the additional restrictions imposed by the new Order of the English Ministry of Agriculture and Fisheries [see this *Review*, ii, p. 591] on the introduction of Scottish-grown potatoes into England and Wales. Under the Order of 1918, all occupiers of gardens, allotments, &c., not exceeding half an acre in extent, situated within districts scheduled as infected areas, were prohibited from planting potatoes other than those varieties approved by the Board of Agriculture for Scotland as immune from wart disease; by the provisions of the new Order, this prohibition is now extended to all occupiers in the whole of Scotland of pieces of land not exceeding half an acre, and to all occupiers of private gardens whatever the area. Certain areas, a revised list of which is given, will continue to be scheduled as infected areas solely for the purposes of the Orders made by the English Ministry of Agriculture and Fisheries and the Irish Department of Agriculture governing the entry of potatoes, but no special restrictions will be applied to these areas by the Scottish Board of Agriculture.

Silver leaf order 1923.—*Journ. Min. Agric.*, xxx, 4, p. 371, 1923.

The Silver Leaf Order of 1919 has been superseded by a fresh Order known as the Silver Leaf Order of 1923, which came into effect in England on 1st June 1923. The new Order provides for the destruction of dead apple, as well as plum trees and wood, the date laid down for the completion of this work being 15th July each year instead of 1st April.

In addition to these requirements the Ministry strongly recommends growers to cover with anti-fouling paint, white paint, or tar, all wounds of apple or plum trees inflicted by cutting, pruning, or otherwise. Such wounds are particularly liable to give entry to *Stereum purpureum* [the cause of silver leaf disease], and grave risks of infection are incurred by leaving them unprotected.

IMPERIAL BUREAU OF MYCOLOGY

REVIEW

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Abbott (E. V.). **The occurrence and action of fungi in soils.**—*Soil Science*, xvi, 3, pp. 207–216, 1923.

The object of the work described in this paper was to study certain activities of various soil fungi, especially in relation to sulphur and phosphorus.

Twenty-eight species of fungi, representing twelve genera, chiefly Mucoraceae, *Aspergillus*, *Penicillium*, and Fungi Imperfecti, were isolated from five different types of Iowa clay and loam soils, the lime requirement of which ranged from 0 to 5 tons per acre.

The most satisfactory medium for the isolation of the fungi proved to be Waksman's synthetic medium [see this *Review*, ii, p. 233], which has a depressing effect on bacterial development.

With the exception of *Penicillium commune* and *P. pinophilum*, all the organisms tested had a relatively high ammonifying power when tried on either dried blood or cottonseed meal added to soil. In general, the Fungi Imperfecti were more vigorous ammonifiers than *Aspergillus* or *Penicillium*. *Mucor glomerula* produced the highest percentage of ammonia from cottonseed meal, liberating 65·4 per cent. of its nitrogen in the form of ammonia. Except for *Acrostalagmus albus*, which produced the highest percentage of ammonia (35·7) from dried blood and slightly less (33·4) from cottonseed meal, all the species tested ammonified the latter more readily than dried blood.

Five species, *Aspergillus fumigatus*, *A. flavus*, *Penicillium funiculosum*, *P. luteum*, and *Cladosporium herbarum* were shown to be capable to some extent of liberating soluble phosphorus from raw rock phosphate mixed with soil, as measured by the ammonium citrate method.

Penicillium luteum was the only organism tested which had the power of oxidizing free sulphur mixed with soil to the sulphate

form. All the seven strains of the organism isolated showed about the same capacity for sulphur oxidation.

With compounds of sulphur and raw rock phosphate mixed with soil only three organisms, *Penicillium funiculosum*, *Aspergillus koningi*, and *Mucor glomerula* showed consistent gains in the quantity of citrate-soluble phosphorus liberated through successive incubation periods of 15 days. Sulphur evidently stimulated the action of the two last-named on rock phosphate on which they had no appreciable effect in its absence. With very few exceptions the remaining organisms showed a decrease below the control after 15 days, a relatively large increase after 30 days (especially *Aspergillus niger* and *Monilia* sp.), and a fresh decrease by the end of 45 days. These variations are perhaps due to the development of successive 'generations' of the organisms, the phosphorus produced and utilized by one generation being rendered soluble by autolysis as it died.

BIOURGE (P. H.). **Les moisissures du groupe Penicillium Link.** [Moulds of the *Penicillium* group].—*La Cellule*, xxiii, 1, 330 pp., 36 double pl. (13 col.), 1923.

This is a monographic treatment of all the accepted species (125) of *Penicillium* which the author has had in culture. Their colour reactions in face and reverse on uniformly selected media are described and illustrated, and the author has admitted no species which cannot be macroscopically differentiated; the essential microscopical characters are also detailed and figured. A list of all species referred in literature to *Penicillium* is given, together with a selected bibliography of 266 titles. In his sub-section *anomala* the author includes the species belonging to *Stysanus* Corda and *Scopulariopsis* Bain. (*Acaulium* Sopp); this section includes species still listed by authors in *Monilia, Spicaria, Torula,* and *Oospora.* He maintains the sub-genus *Monoverticillium* Biourge (1920) of the genus *Penicillium* for what he terms the *Aspergilloides* group, defining it on morphological characters to include *Citromyces* Wehmer, which was based on a physiological reaction; and for the time being leaves open the question whether this sub-genus can be definitely separated from the *Microaspergillus* [*fumigatus*] section of *Aspergillus.*

AVERNA-SACCA (R.). **Algumas das molestias cryptogamicas do tabaco (Nicotiana tabacum).** [Some of the cryptogamic diseases of Tobacco (*Nicotiana tabacum*).]—*Bol. de Agric. São Paulo*, Ser. xxiii, 7–8, pp. 201–268, 31 figs., 1922. [Received 1923].

In this paper an illustrated account is given of the chief fungous diseases of tobacco with recommendations for their control; in several cases a list of resistant and immune varieties is also given. A section is devoted to tobacco mosaic, and another to the principal fungi attacking tobacco leaves in warehouses.

Amongst the records of interest the following may be mentioned. The true rust of tobacco, *Uredo nicotianae* Anas., Sacc., & Splend., previously only known in Italy, was found by the author on two seedlings of Kentucky tobacco grown at Piracicaba in Brazil. The

sori develop on the under surface of the leaves and contain roundish, ellipsoidal, or oblong-obtuse uredospores, 24 to 32 μ in diameter, and with warty walls. On old stems affected by *Macrosporium tabacinum* E. & E., a *Pleospora* was found which is considered to be the perfect stage of the former fungus and is named *P. nicotianae* n. sp. The ascospores are 19 to 27 by 8 to 11 μ and have 3 to 8 transverse septa with 1 or 2 longitudinal. Other new species stated to be pathogenic on tobacco in Brazil are *Macrophoma tabaci, Placosphaeria nicotianae,* and *Colletotrichum nicotianae.*

Cytospora nicotianae Averna [? n. sp.] is described and figured as the cause of a stem disease of characteristic appearance. *Lasiodiplodia* [*Botryodiplodia*] *theobromae* is stated to attack tobacco plants in Brazil, causing a gummy degeneration of the tissues. Tobacco mildew (*Erysiphe cichoracearum*) also occurs and is stated to bear perithecia on the leaves, one of these being figured. Two species of *Cercospora* (*C. nicotianae* E. & E. and *C. solanicola* Atk.) are said to attack the leaves in Brazil. Wilts due to *Fusarium* and *Verticillium albo-atrum* are also described.

GARD (M.). **L'Armillaria (Armillariella Karst.) mellea Vahl et le pourridié du Noyer.** [*Armillaria* (*Armillariella* Karst.) *mellea* Vahl and the root rot of the Walnut tree.]—*Rev. Path. Vég. et Ent. Agric.*, x, 1, pp. 55–62, 3 pl., 3 figs., 1923.

This paper contains the results of the author's studies of the root rot of walnuts caused by *Armillaria mellea.* He has been successful in tracing actual connexion between the rhizomorphs and sporophores of the fungus (both of which, he notes, can be stained with ruthenium red) and thus definitely established the identity of the pathogen.

The spores were found to germinate and give a well-developed mycelium on sterilized manure, the optimum temperature for germination being 18° to 20° C.

The author is satisfied from his observations that the fungus can attack perfectly healthy walnut trees growing in the vicinity of diseased ones. Moreover vines planted in infected clearings from which the old stumps are not completely removed inevitably take the disease. Oaks are rarely attacked in France, though the fungus is frequently found on oak stumps in woods.

Iron sulphate was found to inhibit germination of the spores and to prevent the development of the mycelial strands. Its application in the form of powder to the base of infected trees, about the middle of September, is recommended in the early stages of attack. The best remedy may prove to be grafting on resistant stocks, as is done in California, where *Juglans hindsii* and *J. californica* are used. In France only *J. nigra* has been tried as a stock, but tests of *Carya* and *Pterocarya* are being arranged for.

Walnut-blight. Introduction of immune variety by the Department.—*New Zealand Journ. of Agric.*, xxvii, 1, p. 25, 1923.

The only hope of controlling effectively the bacterial disease (*Pseudomonas juglandis*) of walnuts, which, of late years, has reduced the production of walnuts in New Zealand to an almost

negligible quantity, is stated to appear to lie in grafting the susceptible commercial varieties on immune stocks. In California the native black walnut (*Juglans hindsii*) has long been used for supplying such stocks, and the Department of Agriculture is introducing it into New Zealand for the same purpose. In 1922 a bushel of nuts from it was distributed among leading nurserymen and a considerable number of trees should be available for sale to the public in the spring of 1924 or 1925. Budded trees usually begin to bear nuts at the third year. In 1915 a number of California black walnuts were sown and in a few years these should supply nuts for raising stocks, as seedling trees usually fruit in 9 to 12 years.

HUNT (N. R.). **Notes on the occurrence and growth of cankers of Endothia parasitica.**—*Phytopath.*, xiii, 8, pp. 366–371, 1923.

From 1913 to 1915 the writer conducted a series of spraying experiments with lime-sulphur and Bordeaux mixture for the control of chestnut blight (*Endothia parasitica*) in an orchard on the Blue Ridge Mountains, Virginia, U.S.A. A study of the rate of growth of the cankers was made and the results used to calculate the probable dates of infection by a method which is briefly described. Notwithstanding the immense number of spores produced by the fungus, a relatively low percentage of wounds, thousands of which were inflicted by storms and mechanical operations, became infected. Proximity to diseased trees did not ensure rapid infection. Grafted trees showed less than 10 per cent. of blight as compared with 21 per cent. in the ungrafted. Spraying controlled the disease to some extent but not sufficiently to justify the cost.

There were more cankers on the east and west sides of the trees than elsewhere, a fact for which no explanation is offered. The amounts of growth made by large and small cankers appear to indicate that the rate of development is not greatly affected by size. They seem to grow slightly faster on native than on grafted trees.

BIERS (P.). **Le Schizophyllum commune Fries sur Châtaignes du Japon.** [*Schizophyllum commune* Fries on Japanese Chestnuts.]—*Rev. Path. Vég. et Ent. Agric.*, x, 2, pp. 151–153, 1923.

Chestnuts sent from Japan to the Natural History Museum in Paris, carefully packed in a zinc-lined box, arrived covered with a white mycelium, which gave rise to the sporophores of *Schizophyllum commune*. Notes are given on the variability of this fungus and attention called to the danger of its transport over long distances in this manner.

HAASIS (F. W.). **Root rot as a factor in survival.**—*Amer. Journ. of Forestry*, xxi, 5, p. 506, 1923.

Two trees of white pine [*Pinus strobus*] in sample plots at the Appalachian Forest Experiment Station were found, four months after thinning, to be infected by *Fomes annosus*, which had apparently weakened the roots to such an extent that they gave way during a spell of exceptionally windy weather.

It was pointed out by Dr. Hedgcock, of the Bureau of Plant Industry, that this factor could readily cause many blanks in

a wild pine stand and thus clear the way for the mixtures of pines and hardwoods which are prevalent in the Southern Appalachians. Possibly certain observations on tolerance and suppression could be better interpreted in terms of root-rotting fungi than in those of light requirements. A detailed study of such relations would undoubledly yield results directly applicable to silvicultural practice.

RATHBUN (ANNIE E.). **Damping-off of taproots of Conifers.**—*Phytopath.*, xiii, 9, pp. 385–390, 1923.

In order to secure information as to the degree of injury resulting respectively from root and hypocotyl infection of conifer seedlings with the various organisms involved in damping-off [see this *Review*, ii, p. 5], and also as to the relative virulence of the latter, direct inoculation experiments with *Pythium de Baryanum*, *Corticium vagum*, *Fusarium* spp., *Botrytis* spp., and miscellaneous fungi were conducted [by methods which are briefly described] on the tap roots of *Pinus banksiana*, *P. resinosa*, and *Picea engelmanni*.

The results of the tests showed that *P. de Baryanum*, *Rheosporangium aphanidermatus*, *Fusarium arthrosporioides*, and *F. sporotrichoides* were very virulent under artificial conditions. The last three, however, have never been found naturally infecting coniferous seedlings, and the first-named must, therefore, be regarded as the most dangerous parasite. *Corticium vagum*, *Botrytis cinerea*, *Phomopsis juniperovora*, *Phytophthora* sp., and strains of the moniliform section of *Fusarium* caused considerable decay of the tap roots; while *Mucor racemosus*, *Pythium artotrogus*, and several other species of *Fusarium* tried are apparently non-parasitic.

ARNAUD (M. & MME. G.). **Notes de pathologie végétale.** [Phytopathological notes.]—*Rev. Path. Vég. et Ent. Agric.*, x, 2, pp. 154–161, 1923.

Notes are given concerning various plant diseases observed by the authors during a tour in the south of France in the spring of 1923. On oleanders [*Nerium oleander*] the bacterial tumours described by Tonelli (*Bull. Soc. Bot. Ital.*, pp. 178–179, 1904) are stated to be fairly common. It is suggested that the pathogen [*Bacillus oleae*] may be carried by insects. Pruning out all infected parts is recommended. Mildew (*Oidium ceratoniae* Comes) is very common in certain places on the carob tree (*Ceratonia siliqua*) and is said in Italy to cause much damage, but this is not the case on the Riviera. *Hysterographium fraxini* was found frequently on the olive and is believed to hasten the death of small branches in the interior of the leafy crown. *Cycloconium oleaginum* is rare on olives in this region. Amongst the rusts, four species of *Gymnosporangium* were found on *Juniperus communis* and *J. oxycedri*, namely, *G. clavariaeforme* and *G. tremelloides* on the former and *G. oxycedri* and *G. gracile* on the latter: it is thought that the *Roestelia cancellata* specimens in this district may belong to *G. oxycedri*, since the host of *G. sabinae*, namely, *Juniperus sabina*, does not occur. On *Pinus halepensis*

witches' brooms similar to those described by Dufrénoy (*Phytopath.*, xi, p. 27, 1921) on *P. maritima* (*P. pinaster*) and attributed by him to bacterial infection, were observed. *Trametes pini* was also found to be common on this tree.

Snell (W. H.). **The effect of heat upon the mycelium of certain structural timber-destroying fungi within wood.**—*Amer. Journ. of Botany*, x, 8, pp. 399–412, 1 diag., 1923.

The application of heat to structural timber *in situ* having been suggested by previous investigators as a possible remedy against decay caused by fungi, the thermal death relations in moist and dry heat of the mycelium of five fungi (*Lenzites saepiaria, L. trabea, Trametes serialis, T. carnea*, and *Lentinus lepideus*) found growing in cotton mill roofs were tested.

The experiments were carried out on blocks of Sitka spruce $\frac{3}{4}$ by $\frac{3}{4}$ by 1 inch, taken from cultures, four months and one year old respectively, of the five fungi used, and exposed to both moist and dry heat for varying intervals at different temperatures. In general, the resistance of the mycelium to dry heat was greater than to moist heat. Three and a half days' exposure to 44° C., and twelve hours to 55° C. moist heat was necessary to kill all the fungi, while with dry heat the temperature necessary to kill in three days was from above 70° to above 90° C., and all the species were not destroyed in twelve hours until 105° C. was reached.

There were individual differences in the resistance of the various fungi, and the thermal death curves bore no direct relation to the thermal growth curves. *Lenzites saepiaria* had the highest optimum and maximum for growth (32° to 35° and 40° to 44° C. respectively) but the second lowest thermal death curve. *Lenzites trabea* was far the most resistant of the five fungi tested, surviving one day at 100°, three days at 90°, six days at 80°, and nineteen days at 70°, although its optimum growth temperature is only 28° to 30° C. The greater resistance of the mycelium of this species was suspected to be due to the presence of resistant spores within the wood, but none have so far been found in the infected material examined. The mycelium of *T. serialis*, the least resistant of all the fungi tested, succumbed after ten days' exposure at 60°, four at 70°, two at 80°, and one at 90°. The thermal death points of the other three fungi were nearer to those of *T. serialis* than to those of *L. trabea.*

Even from these tentative results of tests on small blocks it may be concluded that heat applied as a sterilizing agent to structural timber in buildings can be of little use against the enemies mentioned above. Periodical heating of such structures, however, is recommended for drying out the timbers and arresting decay, to which partially green wood is particularly liable.

It may be assumed that the results obtained with the fungi used in the tests will apply to the kiln-drying of coniferous timbers, a process which may be relied upon for the internal sterilization of structural timbers with regard to most, if not all, mycelia of wood-destroying fungi. In such preliminary treatments as the application of saturated steam, superheated steam, or hot oil, there should also be sufficient heat present to kill all the mycelium in the wood,

especially if reinforced by subsequent vacuum treatments to rupture the fungus cells.

SCHMITZ (H.). **Notes on wood decay. I. The wood-destroying properties of Polyporus volvatus.**—*Amer. Journ. of Forestry*, xxi, 5, pp. 502–503, 1923.

Experiments to test the wood-destroying properties of *Polyporus volvatus* [see this *Review*, ii, p. 187] were conducted at the Idaho School of Forestry. Small, weighed blocks of various woods were placed in jars with moist applewood sawdust, and sterilized. The flasks were then inoculated with *P. volvatus*, and incubated for five months at 28° C. At the end of this period the blocks were removed, dried to constant weight at 102° C., and again weighed. The difference in weight between the first and second weighing, minus the loss in weight of the uninoculated controls, was considered to indicate the amount of decay which had occurred [see this *Review*, ii, p. 51].

The average loss in weight per cent. in the various species tested was as follows: *Larix occidentalis* 3·5; *Picea engelmanni* 14; *Pseudotsuga taxifolia* 2·3; *Pinus ponderosa* 1; *P. ponderosa* (sapwood: flask contaminated with *Aspergillus*) 2·4; *P. monticola* (sapwood) 1·1; *Tsuga heterophylla* 1·6; *Abies grandis* 11·7.

These results indicate that *P. volvatus* is at least able to cause severe decay of Engelmann spruce and white fir, the wood of which became soft and friable. The maximum loss in weight in these two species was 19·3 and 17·3 per cent. respectively.

COONS (G. H.). **Celery blight or leaf spot.**—*Quart. Bull. Michigan Agric. Exper. Stat.*, v, 4, pp. 190–193, 2 figs., 1923.

Considerable losses—in some seasons amounting to over a million dollars—are annually caused to celery growers in Michigan by blight (*Septoria apii*), a disease which is most prevalent in wet seasons. Infection usually takes place on the young leaves in the heart, and becomes visible from the development of spots bearing numerous small pycnidia; in wet weather the latter extrude large numbers of spores which are disseminated by the splash and drip of the rain.

The disease can be readily controlled by the following measures. As it is frequently carried by seed, the latter should be disinfected by soaking for 2 or 3 minutes in a solution of mercury bichloride, or for 15 minutes in a 1:240 solution of formalin; the use of untreated two-year-old seed is also considered safe. Seed-beds should be made on clean ground and should not be mulched with celery tops from a preceding crop. The seedlings should be sprayed every week or ten days in the seed-beds with half strength Bordeaux mixture, the last spraying being given immediately before setting them in the field. After setting, the plants should be treated every ten days or fortnight, the spray being directed into the hearts, since these are the most susceptible parts. If two or three crops are grown in one season, it is essential to keep the first one free from blight in order to prevent infection of those following.

WELLES (C. G.). **A new leaf spot disease of Onion and Garlic.**—*Phytopath.*, xiii, 8, pp. 362–365, 1 pl., 1 fig., 1923.

Since January 1922 a severe leaf spot of onion (*Allium cepa*) and garlic (*A. sativa*) has been observed at the Los Baños College of Agriculture, Philippine Islands.

The symptoms differ slightly on the two hosts. On onion the young lesions appear as circular, yellow, chlorotic spots, 3 to 5 mm. in diameter, most numerous at the upper end of the leaf and decreasing towards the base. At a more advanced stage the spots coalesce at the end of the leaf. Below, there are numerous separate lesions giving a mottled appearance. Subsequently the end dries out and turns greyish-brown, the single lesions sometimes developing a brownish centre composed of dead tissue. In very severe cases the entire leaf is killed and turns greyish-brown. Fruiting bodies are visible on the dead portions of the lesions or may appear as black specks on the chlorotic tissue.

On garlic the lesions begin as small, round or irregular, chlorotic spots on very young leaves, and spread rapidly until the entire upper end of the leaf is killed. Instead of the numerous separate lesions occurring on onion leaves, the fungus appears to proceed in a mass down those of garlic. The diseased tissue is deliminated by a narrow band of chlorotic tissue about 3 mm. in width. After the fusion of the original lesions the progress of the disease is rapid and fatal, the losses, which may reach 45 per cent. of the plants, being more serious than in onions.

The author's recent inoculation experiments have shown that *Cercospora*, to which genus the organism causing the disease is referred, is very indiscriminate in its choice of hosts. Thus a species isolated from *Phaseolus lunatus* attacked all legumes on which it was placed and many non-leguminous plants. Hence onion and garlic may not be the only hosts of the fungus under discussion. Nevertheless, it is believed to be an undescribed species (characterized by hyaline conidia of the usual type, 48 to 79 by 5·3 to 7·9 μ and with 2 to 15 septa), to which the name *C. duddiae* is given.

Little benefit resulted from an attempt to control the disease by spraying with Bordeaux mixture, possibly because the application was made too late.

ANDERSON (P. J.). **The relation of soil moisture to formaldehyde injury of Onion seedlings.**—*Phytopath.*, xiii, 9, pp. 392–403, 2 graphs, 1923.

Since 1918 investigations have been carried on in the Connecticut Valley to ascertain at what strength formaldehyde solutions, applied at the time of planting for the control of onion smut [*Urocystis cepulae*], could be used without impairing the germination of the seed. During the first years of the experiments such concentrated applications as 1 part of formaldehyde in 64 galls. of water per 3,200 ft. of drill and 1 in 50 per 3,000 ft. were employed with impunity, whereas in the dry season of 1921 the same strength caused very decided losses. Further tests of the effect of the formaldehyde treatment in soils with different percentages of moisture showed clearly that the amount of injury to the seed decreased uniformly

with the increase in the percentage of soil moisture. It was also shown that the amount of injury in a dry soil could be reduced by increasing the dilution of the formaldehyde without simultaneously reducing the actual quantity of formaldehyde per unit of drill.

Summarizing the practical application of numerous tests, the 1–128–3,000 formula is stated to be the safest for use in extremely dry and dusty soils. If, however, the soil is fairly wet on the day of planting, considerable time and labour may be saved by the employment of a concentrated formula, such as 1–50–3,000. The amount of injury to the seed depends on the condition of the soil at the time of planting and application of the fungicide, and is unlikely to be affected by the subsequent weather. Since there is always some loss from the use of formaldehyde, more seed should be allowed per acre in fields where this method of controlling onion smut is practised.

MACMILLAN (H. G.). **Cause of sunscald of Beans.**—*Phytopath.*, xiii, 8, pp. 376–380, 1923.

The annual recurrence, since 1918, of a scalding of the pods and other parts of *Phaseolus vulgaris* in Colorado, led to experiments [the technique of which is described] on the effects of heat and light on the plants. The typical symptoms of the disease were produced by exposing the pods to an arc light, while when a sheet of window glass, which absorbs light of very short wave lengths, was interposed no scald appeared. Exposure to heat alone was not found to produce the symptoms.

The destruction of the epidermal cells of the pods is thought to be caused by light of short wave length. The Colorado bean districts, at an altitude of 4,700 ft. and with a relative humidity of under 20 per cent. for several hours during the heat of the day, would receive a much larger portion of ultra-violet light than is usually the case in bean-growing areas.

FAES (H.) & TONDUZ (P.). **Rapport annuel 1922. Station fédérale d'essais viticoles à Lausanne et Domaine de Pully.** [Annual Report for 1922 of the Federal Station of Viticultural Experiments at Lausanne and the Domain of Pully.]—Reprinted from *Annuaire agric. de la Suisse*, 26 pp., 1923.

The researches on the coitre or hail disease [see next abstract] were continued. Symptoms resembling those of apoplexy of the vine [see this *Review*, ii, p. 528] as reported from France were observed in certain vineyards in the Canton of Geneva. A fungus belonging to the Polyporaceae was isolated from the diseased material and control experiments are in progress.

The results of experimental studies on the contamination of various fruits by rotting organisms (*Penicillium*, *Monilia*, *Botrytis*, *Rhizopus*, and *Trichothecium*) showed that penetration is ordinarily effected through abrasions of the surface. A study of the environmental conditions predisposing to the spread of infection from diseased to healthy fruit is in progress.

The *Monilia* disease of apricots [see this *Review*, i, p. 180] caused severe damage in Valais during 1922. Fairly good control was secured by the use of alkaline polysulphides.

FAES (H.) & STAEHELIN (M.). **Nouvelle contribution à l'étude du coître de la Vigne (Coniothyrium diplodiella) ou maladie de la grêle.**—[New contribution to the study of coitre of the Vine (*Coniothyrium diplodiella*) or hail disease.]—Reprinted from *Annuaire agric. de la Suisse*, 10 pp., 2 figs., 1923.

Investigations on the coitre, livid rot, or hail disease of the vine (*Coniothyrium diplodiella*), a preliminary account of which has already appeared [see this *Review*, ii, p. 45], were continued in 1922, when severe damage occurred in the Cantons of Ticino and Vaud. In the former the financial loss was estimated at over one million francs, and in the latter the vines were attacked to the extent of 70 or 80 per cent.

On 5th August 1922 healthy grapes were inoculated with diseased material collected in 1920 and 1921 respectively: eleven days later the typical symptoms of the disease began to appear, and by 4th September a well-marked attack of livid rot was in evidence. Thus the viability of the spores extends over a period of at least two years.

Temperature exerts a very marked influence on the development of the disease. A comparison of the results of inoculation tests carried out during the dry, hot summer of 1921 with those of the 1922 experiments showed that the low temperatures of the latter year considerably retarded the development of the fungus, which only formed pycnidia 12 to 14 days after inoculation in 1922 as against 5 to 6 days in 1921. Vines inoculated in the open air took 12 to 14 days for pycnidial development, while those in the greenhouse formed pycnidia in 7 to 8 days. Atmospheric humidity does not appear to be an important factor in the development of the fungus.

The mycelium is usually restricted to the intercellular spaces of the host, but its presence causes the protoplasm of the cells to become flocculent and the cellular contents to turn brown. Infected grapes first become soft and juicy, and subsequently mummify. The latter condition is due to the formation of a firm tissue in the skin of the grape, in which the pycnidia develop.

The importance of sugar as a factor in the development of *Coniothyrium*, noted in the previous paper, was again observed. Analyses made in 1922 showed that the grapes were poor in sugar as late as the middle of July, when they contained only 1 per cent., and the parasite was unable to develop satisfactorily until the middle of August, when the sugar content was 10 to 12 per cent.

The results of experiments in the treatment of the disease, carried out on Chasselas vines two hours after inoculation, showed that infection was arrested by the application of (*a*) 1 per cent. black soap and 2 per cent. calcium bisulphite; (*b*) 1 per cent. black soap and 2 per cent sodium bisulphite; or (*c*) 0·5 per cent. black soap and 0·5 per cent. formalin. Some injury to the fruit, however, resulted from the bisulphite treatments. The ordinary copper-lime mixtures, as well as copper-nickel and copper-nickel-zinc sulphates, nickel sulphate and lime, sulphur, and copper-sulphur dust, failed to give adequate control. Preventive treatments are impracticable, since the hailstorms which bring on the outbreaks cannot be forecasted.

Cadoret (A.). **Bouillies bleues et vignes bleues. 7e année d'expériences.** [Blue mixtures and blue vines. Seventh year of experimental work.]—*Prog. Agric. et Vitic.*, xl, 16, pp. 380–382, 1923.

In 1915 the loss in France from vine mildew [*Plasmopara viticola*] is stated to have amounted to 70 per cent. of the harvest, equal to 1,600,000,000 francs [£64,000,000 at the rate of exchange ruling at the time]. In that year the author called attention in the *Progrès Agricole et Viticole* to the freedom from attack of vines treated with the blue alkaline Bordeaux mixture recommended by him. Subsequent experience has confirmed the value of the treatment, the details of which must, however, vary with the latitude. In the zone north of the line Bordeaux-Briançon the following spraying programme is recommended: (1) two consecutive sprayings between 1st and 8th June; (2) two consecutive sprayings between 15th and 25th June; (3) one treatment towards 10th July; the object being to keep the vines continuously covered with the mixture during the critical period between 1st and 14th July. The formula advised is copper sulphate 2·5 to 3 kg., fat lime [high grade lime made from pure limestone] 2·5 to 3 kg., water 100 litres. Subsequently, sprayings with mixtures consisting of 1 kg. copper sulphate and 2 kg. lime to 100 litres water can be carried out according to circumstances.

In the region south of the line indicated above the critical period lasts from 15th May to 25th June: two treatments with the blue alkaline preparation between the 15th and 23rd May, two between the 1st and 9th June, one on the 20th June, and another on the 10th July are recommended. For the July application, and any subsequent sprayings found necessary, the mixture may consist of 1 per cent. copper sulphate and 2 per cent. lime [1 and 2 kg., respectively, per 100 litres water].

In Algeria and Tunis the season is earlier and the vines must be kept blue from 22nd April to 25th June by two treatments between 23rd April and 1st May, two between 10th and 20th May, and one between 5th and 10th June, followed by the application of the weaker mixture indicated above on 1st July and later if circumstances require it.

Chupp (C.). **Diseases of field and vegetable crops in the United States in 1922.**—*Plant Disease Bull. Supplement* 26, 163 pp., 14 maps, 1923.

This annual review of the diseases of field and vegetable crops in the United States has been prepared on the lines adopted in previous reports of the same nature [see this *Review*, ii, p. 204].

The certification of seed potatoes is stated to be gaining ground every year, over 2,500,000 bushels having been passed in the United States and Canada during 1922. Mosaic is the most dreaded of all potato diseases and was extremely prevalent during the period under review, the losses in Louisiana alone being estimated at 25 per cent. The disease has been observed to spread in the absence of aphids, and the question is raised whether other insects may not be capable of transmitting it [see also this *Review*, iii, p. 161]. Another disease which has caused serious alarm of recent

years is yellow dwarf [see this *Review*, i, p. 449], which in 1922 was found in Vermont, New Jersey, and Pennsylvania, in addition to New York. There appear to be no varieties immune from the disease. Late blight (*Phytophthora infestans*) caused a loss of only 8 per cent. in the eight States where it is of major importance, as compared with 18 and 20 per cent. in 1919 and 1920 respectively.

The diseases of tomatoes, sweet potatoes, beans, onions, cruciferous crops, and cucurbits are enumerated, and notes on their prevalence, distribution, losses, and other points of interest are given.

A full account is given of the southern sweet potato certification service which is being organized on the lines adopted for potato inspection in the north.

Mosaic disease of sugar-cane is stated to be increasing both in importance and in geographical distribution. Owing to its prevalence in the western part of Florida that region was placed under quarantine by the State Plant Board. In Georgia the Cayana 10 variety is stated to be highly resistant.

Sections on the diseases of sugar beet, tobacco, and miscellaneous vegetable crops complete the Bulletin, which is furnished with copious bibliographical references and brief abstracts of the more important literature.

MARCHAL (P.). **Rapport sur les travaux de la Station de Pathologie végétale de Paris en 1922.** [Report on work done by the Station for Plant Pathology of Paris in 1922.]—*Ann. des Épiphyties*, ix, 1, pp. 70–72, 1923.

The Station's main activities during the period under review in this report included studies of the degeneration diseases and 'filosité' of the potato by Foëx. With regard to the latter trouble, the following conclusions have been reached: (1) nothing appears to connect it with the degeneration diseases [mosaic, leaf roll, &c.]; (2) it does not always affect all the eyes of a tuber to the same degree, those at the stem end being influenced to a greater extent than those towards the apex, but there are other differences found in the vigour of the sprouts which are not related to their position; (3) preliminary germination tests do not always give a reliable indication of the condition of the eyes; (4) a large proportion of affected seed pieces remain intact until harvest.

The brownish discoloration of the vascular ring sometimes found in potato tubers is generally associated with fungous or bacterial attacks. In cases where it cannot be traced to any definite organism it does not appear to be connected in any way with the degeneration diseases.

Ten distinct types of potato mosaic are stated to have been recognized, several of which appear to be reproduced unchanged in the progeny. The accumulation of starch is a constant phenomenon in leaf roll, but not the conservation of the seed piece, which occasionally decays. In mosaic there is never an accumulation of starch and only rarely a conservation of the seed piece. A reddening of the upper leaflets, which has been observed in several regions of France, is accompanied by starch accumulation and by

a slight degree of phloem necrosis; its relationship to the degeneration diseases is not indicated.

Potato dartrose (*Vermicularia varians*) occurred in 1922 in all parts of France, and a *Verticillium*, morphologically resembling, but biologically differing from *V. albo-atrum*, was responsible for a rotting of the tubers.

VAN HALL (C. J. J.). **Ziekten en plagen der cultuurgewassen in Nederlandsch-Indië in 1922.** [Diseases and pests of economic plants in the Dutch East Indies in 1922.]—*Meded. Inst. voor Plantenziekten*, 58, 42 pp., 1923.

Notes are given on the principal fungous diseases of economic plants observed in the Dutch East Indies during 1922.

Potato scab caused by *Actinomyces* [*scabies*] was prevalent on parts of the west coast of Sumatra. Mosaic, leaf roll, and sprain were reported from Preanger, Pasoeroean, and Besoeki.

Groundnut (*Arachis hypogaea*) was very generally attacked by slime disease (*Bacterium solanacearum*). On the west coast of Sumatra the imported variety No. 3 appears to be highly resistant. In Kediri leaf curl [rosette] caused great reduction (up to 50 per cent.) of the crop.

A canker of djati [teak: *Tectona grandis*], first observed in 1921, appears to be spreading in the south of Bodjonegoro, where it is causing considerable alarm. Djamoer oepas [*Corticium salmonicolor*] was prevalent in young plantations of *Acacia oraria* and *Buchanania*.

Rubber root diseases in Sumatra were chiefly due to *Fomes lignosus* and a *Fomes* wet rot which may not be the same as that caused by *F. pseudoferreus* in Java. The hyphae in culture are brick-red instead of crimson as in the last-named fungus. In West Java *F. lignosus* occurred chiefly in young plantations on loose sandy soil. It has destroyed 70,000 trees in two plantations in the Lampong district during the last few years. *P. pseudoferreus* was severe in West Java on heavy clay in old plantations.

Mouldy rot (*Sphaeronema* sp.) and stripe canker (*Phytophthora* sp.) were prevalent on rubber in some districts of Java, generally as a result of overcrowding. In Besoeki stripe canker caused severe damage at high altitudes with a heavy rainfall, especially on estates interplanted with coffee. Patch canker [*Phytophthora faberi*] increased considerably in Sumatra, occurring chiefly on the primary bark of the base of the trunk. *Phytophthora* leaf fall occurred in Besoeki, but less severely than in 1920.

The incidence of brown bast of rubber declined during 1922, largely owing to the adoption of more conservative systems of tapping; tapping every three days was especially beneficial.

Amongst other rubber diseases mentioned are pink disease (*Corticium salmonicolor*), *Fomes lamaoensis* on seedlings, *Ustulina zonata*, *Hypochnus* sp. causing a 'cobweb' disease, and mildew (*Oidium* sp.) which caused many young leaves to drop but did little damage on the whole.

Cinchona was attacked by *Corticium salmonicolor*, to which the young Ledger seedlings are particularly susceptible. The same variety also suffered considerably from root diseases caused by *Armillaria mellea* and *Rosellinia* sp.

Robusta coffee was severely attacked in Sumatra by leaf disease (*Hemileia vastatrix*).

Maize was attacked in various districts by downy mildew (*Sclerospora javanica*), less virulently, however, than in 1921.

Oil palms in Sumatra again suffered severely from crown disease [see this *Review*, i, p. 20, ii, p. 9], up to ten per cent. of the trees in young (two to three years) plantations being attacked. It is believed to be due to physiological disturbances in the tissues, of unknown causation.

Bananas were attacked on the west coast of Celebes by blood disease [see this *Review*, ii, p. 225]. Certain localities at a short distance from the coast, however, showed no trace of infection.

Rice suffered from root rot in many districts, the damage being particularly severe in Bantam, where 24,476 bouw [1 bouw = 0·71 hect.] were affected, Rembang, and Soerabaja (where 50 per cent. of the crop was a failure).

Sugar-cane was slightly damaged by pineapple disease [*Thielaviopsis paradoxa*] and red rot [*Colletotrichum falcatum*] after the June rains, and a decay of the setts also occurred during the wet season. Mosaic disease, gummosis, and sereh disease were not particularly severe. Gummosis primarily affects the varieties EK 2, 2714 POJ, and Randoegoenting 667, while sereh is prevalent on damp, heavy soils on DI 52. Root rot was less severe than in 1921, occurring principally in canes planted during the rainy weather of May and June, and at the close of the east monsoon in localities where the drought had disorganized the water-conducting system of the plants.

Tobacco in Deli was attacked chiefly by slime disease (*Bacterium solanacearum*). *Phytophthora nicotianae* was important only on seedlings, and *Sclerotium rolfsii*, *Stemonitis herbatica*, and black rust (*Bacillus pseudozoogloeae*) were sporadic only. Mosaic disease caused severe damage, in some cases amounting to 50 per cent., on estates in the plains. A fungus allied to *Penicillium* was observed on fermenting tobacco. The stems of seedlings recently planted out were attacked by a form of scorch due to an unknown cause. In the Vorstenlanden *Phytophthora nicotianae* occurred on an epidemic scale on the No. 2 variety. Slime disease was extremely prevalent in this area in fields where tobacco followed cow-pea, whereas it was little in evidence after rice. *Oidium* caused considerable damage in the same district, but the application of sulphur dust to the soil proved efficacious. Mosaic was more severe in Besoeki in 1922 than the previous year, but other diseases were of little importance in that district.

Red rust of tea [*Cephaleuros mycoidea*], which frequently succeeds severe attacks of *Helopeltis*, may be largely controlled by careful pruning and interplanting with green cover crops. Tea root diseases, especially *Rosellinia* and *Fomes*, caused damage amounting, in some cases, to 50 per cent.

Verslag over het jaar 1922. Departement van Landbouw in Suriname. [Report of the Department of Agriculture, Surinam, for the year 1922.] 106 pp., 1923.

The section on plant diseases (pp. 25–29), contributed by G. Stahel, contains the following references of interest.

The most noteworthy occurrence during the period under review was the extensive spread of mosaic disease of sugar-cane, especially on the D118 and D625 varieties. In some fields 20 per cent. of infection was recorded. Attempts are in progress to check the disease by roguing and the use of healthy cuttings. Notwithstanding careful seed selection the valuable Bourbon variety is becoming increasingly susceptible to 'roodsnot' (*Thielaviopsis paradoxa*) [? *Colletotrichum falcatum*].

Erythrina glauca in Upper Surinam has been severely attacked by an obscure disease producing a water soaked and discoloured appearance of the cortex, especially in the vicinity of pruning wounds. Bacteria found in the tissues were isolated and inoculated into healthy trees with negative results. Nowell, in a verbal communication, described a similar disease occurring in St. Lucia, bacterial inoculation proving unsuccessful there also. It is uncertain whether the disease is identical with that recorded in 1920 [see this *Review*, i, p. 2]. The results of 50 inoculation tests with *Sphaerostilbe* isolated from diseased cortex were negative. The Trinidad and Anauca varieties of *Erythrina* appear to be immune, and it is suggested that they, with *Inga ingoides*, *I. alba*, and *Enterolobium cyclocarpum*, should replace the susceptible *E. glauca* as shade trees in plantations.

The cultivation of the Gros Michel banana must be temporarily abandoned, or at any rate restricted, in Surinam owing to the rapid spread of Panama disease [*Fusarium cubense*] wherever this very susceptible variety is exclusively grown. The cultivation of the resistant Congo, Bumulan, and dwarf varieties is recommended.

A die-back of cacao has caused considerable damage, especially in the Commewijne districts where cultivation has been discontinued in severely affected areas. The external symptoms of the disease consist in a sudden drooping and desiccation of the leaves, associated with a dark brown discoloration of the cambium. The dead cells are yellow and their contents granular. Callus is formed at the junction of the dead and healthy tissue.

FARIS (J. A.). **Enfermedades de los productos de valor economico.** [Diseases of economic crops.]—*Rev. de Agric. Republica Dominicana*, xvii, 11, pp. 161–168, and 12, pp. 177–187, 1923.

This is a list of the cryptogamic diseases of economic plants occurring in the Republic of Dominica, arranged by host plants. A list of references is appended.

Work of the Kansas Agricultural Experiment Station during the biennium ending June 30, 1922.—*Kansas Agric. Exper. Stat., Director's Report*, 45 pp., 1 map, 1 fig., 1922. [Received 1923.]

The report contains (pp. 16–17) the following reference of phytopathological interest. Foot rot disease of wheat was found during the two previous years in five counties in Kansas, the organisms associated with its occurrence being *Helminthosporium* sp., *Hendersonia* sp. (*Wojnowicia graminis*), and a fungus, isolated in May 1922, which may prove to be *Ophiobolus cariceti*. The possible connexion between *Wojnowicia* and *Ophiobolus* is being investigated.

Soil infestation appears to be chiefly responsible for transmission, especially where diseased wheat stubble is ploughed under. A study is also being made of rotation, soil amendment, fertilizers, and susceptibility (both of different wheat varieties and of certain grasses suspected to be attacked), in relation to the disease.

Seasonal conditions were probably responsible for the different behaviour of the disease in 1921 and 1922. In the former year infected plants seldom formed heads, and severely diseased fields gave only one-third of the normal yield. In 1922 the affected plants reached the heading stage but did not mature normal grain, the heads either being entirely blighted or the seed shrivelled.

Work and progress of the Idaho Agricultural Experiment Station for the year ended December 31, 1922.—*Idaho Agric. Exper. Stat. Bull.* 131, 69 pp., 1923.

The following references of phytopathological interest, not previously noticed, are included in the Bulletin.

For the past three years investigations have been pursued in the control of western yellow tomato blight [*Fusarium* sp.]. Several of the 80 varieties and some of the selections tested for resistance have given promising results.

Calico and russet dwarf of potatoes [see this *Review*, i, p. 448] appear to be very similar to certain types of mosaic and may be members of the virus group of diseases. Mosaic, leaf roll, and other affections of a similar nature are becoming more destructive every year, and are at present causing heavier annual losses than any other potato disease in Idaho. A selected lot of each of the two principal varieties, Netted Gems and Idaho Rurals, was planted under varying conditions in different parts of the State and carefully rogued during the growing season. Practically the same amount of leaf roll appeared in each of the various plantings, but the incidence of mosaic varied materially, either owing to the effect of different climatic factors or to the spread of infection from wild plants. The results of carefully controlled experiments in the transmission of the disease by insects from infected to healthy plants were positive in the case of pink and green rose aphids (*Macrosiphum solanifolii*), and negative in those of *Myzus persicae*, *Nysius ericae*, *Lygus pratensis*, and others.

The results of seven years' experiments in the value of the cold formaldehyde and corrosive sublimate methods of seed treatment for the control of *Rhizoctonia* [*solani*] on potatoes showed that in the treatment of clean whole tubers the solution can be maintained at the normal strength by adding $\frac{1}{4}$ oz. of corrosive sublimate for every two bushels of potatoes treated. Cut or dirty potatoes rapidly break down the solution, and it has also been found that the tubers should be treated loose instead of in sacks, which reduce the strength of the mixture. The hot formaldehyde treatment [see this *Review*, iii, p. 172] does not appear to be effective against the sclerotia of *Rhizoctonia* under Idaho conditions. By sprinkling the tubers with water and covering for 24 to 48 hours before treatment, however, the efficacy of both the corrosive sublimate and hot formaldehyde methods is greatly increased.

Attempts to control potato scab [*Actinomyces scabies*] by the

use of sulphur [see this *Review*, ii, p. 572] gave unsatisfactory results.

None of the dusts tested during the last two years for the control of bunt of wheat [*Tilletia tritici*] gave as satisfactory results as the standard copper sulphate dip (1 lb. per 5 galls.). The average percentage of infection in a stand of Jenkins Club wheat from artificially smutted seed was 19·5 in the part treated with copper carbonate (2 oz. per bushel), 9·75 in that treated with copper sulphate, and 39·25 in the untreated control plot. In another test there was 9 per cent. of bunt in the copper carbonate plots as compared with 7·5 per cent. in those treated with copper sulphate. The results of field tests on various farms near Moscow were as follows: on Triplet wheat; copper carbonate dust, 3·25 per cent. smut, copper sulphate dip, 2·5 per cent.: on Washington Hybrid; copper carbonate 25·7 per cent. smut, copper sulphate 16·7 per cent., copper sulphate and lime 23·5 per cent. Germination was improved by the use of copper carbonate.

Thirty-fifth Annual Report of the Kentucky Agricultural Experiment Station for the year 1922, 61 pp., 1923.

The following references of phytopathological interest are contained in the Report.

Tests of strains of tobacco resistant to root rot (*Thielavia basicola*) [see this *Review*, iii, p. 13] have been continued. With one exception, all the most widely cultivated stand-up varieties were found to be susceptible to the disease. Apart from increased growth on infected soil, the use of resistant strains has reduced the cost of resetting, which in the common varieties was necessary to the extent of 5 to 50 per cent. Of the nine varieties of black tobacco tested, Dark G was found to be highly resistant but of doubtful value, Kentucky Yellow fairly resistant, and Turkish practically immune; the yield of the others was reduced by 40 per cent. from root rot attacks.

Studies on the overwintering of mosaic diseases of tobacco indicate that infection is carried in the root stocks of the bull nettle (*Solanum carolinense*) and ground cherry (*Physalis* sp.). Negative results were obtained in attempts to transmit the mosaics of bean, red clover, soybean, and pokeweed [*Phytolacca decandra*], and the leaf roll of potato, to tobacco.

Two series of experiments in the transmission of ring spot disease from infected to healthy tobacco plants gave positive results in each case only on a single leaf on one plant out of fifty.

Further detailed studies confirm previous reports [see this *Review*, i, p. 439] as to the extremely high degree of infection caused by root rot of maize. In addition to the organism previously reported to be involved in this disease [*Fusarium moniliforme*], a species of *Helminthosporium* was found in 25 to 30 per cent. of the seeds examined, and species of *Macrosporium* and *Sclerotium* in a small percentage. It was shown by microscopic examination that fungous hyphae may be present in apparently healthy seeds between any of the seed-coat layers outside the aleurone layer, and in any portion of the seed-coat. Tests during the last three years have indicated

that no good results can be obtained by selecting apparently disease-free ears for seed, but in 1922 selection of extremely smooth and extremely rough ears from a lot of 500 selected seed ears of Boone County White maize resulted in an increase of 39 per cent. in favour of the smooth ears.

The wheat crop was greatly reduced by a disease which caused premature ripening, breaking of the straw, and shrinkage of the grains. *Helminthosporium* sp. and the wheat scab organism [*Gibberella saubinetii*] were constantly isolated from the broken joints. The variety Fulcaster showed resistance to this disease.

Fifty-eight lots of oats, barley, and wheat, obtained from widely separated localities in the United States, were found to be heavily infected with seed-borne organisms, as indicated by discoloration of the sheath shortly after germination and subsequent decay of the roots. The modified hot water treatment retarded the development of the organisms in some cases, but did not destroy them.

Red and alsike clover plants grown on unproductive or 'clover sick' soil were exceedingly small but produced a fair yield in the first summer. During the second summer, however, practically all the plants disappeared from the most seriously affected soils.

The method of eliminating potato mosaic by selection of tested seed pieces for planting [see this *Review*, iii, p. 14] was again effective as regards freedom from mosaic, but leaf roll appeared in the crop.

Several lots of apparently normal lettuce seeds were found to be infected with *Macrosporium* sp., as indicated by the outgrowth of this organism from surface sterilized seeds grown on a sterile moist blotter. Other lots of seeds were apparently healthy under these conditions, but stained microtome sections revealed minute strands of a fungus, much smaller than the *Macrosporium*, between the seed-coat layers. The unidentified organism is believed to be the cause of the root rot of this crop described in previous reports, tipburn being a secondary effect.

Pear orchards were decimated by blight [*Bacillus amylovorus*], from which the Douglass variety, however, appears to be immune. This is a good, though not high-class, variety, and its resistance to the disease, which is rapidly destroying the Kentucky pear-growing industry, may prove extremely valuable.

The lime-sulphur-glue formula was an effective substitute for standard lime-sulphur in the control of peach scab [*Cladosporium carpophilum*] and brown rot [*Sclerotinia cinerea*].

WHETZEL (H. H.). **Report of the Plant Pathologist for the period January 1st to May 31st, 1922.**—*Reports Board & Dept. Agric. Bermuda for the year 1922*, pp. 28–32, 1923.

This report continues and completes that for the second half of 1921 already noticed [see this *Review*, ii, p. 305].

Approximately 400 species of fungi of all sorts were collected during the author's stay in the islands and will subsequently be embodied in a complete catalogue of the fungi known to occur in the Colony. Among the rusts *Cerotelium fici* [*Kuehneola fici*] causes defoliation of fig trees and is probably responsible for the dropping of the fruit frequently observed, and *Tranzschelia punctata* [*Puc-*

cinia pruni-spinosae] causes defoliation of peach trees. *Cercospora beticola* was found in the Swiss chard [*Beta vulgaris*] on the leaves of which it forms spots.

Citrus scab was controlled by spraying with lime-sulphur at the rate of 2·5 galls. at 32° Baumé to 100 galls. of water. The first application should be given just before blossoming, the second when a third or half the petals have fallen, and the third seven to ten days later. Bordeaux mixture may be substituted for lime-sulphur on young trees, or on old ones just before they start new growth.

Mosaic of the *Eucharis* lily, causing a stunting and mottling of the foliage and stalks, and a distortion of the flowers, was extremely prevalent and severe. It is believed to be carried by a new species of thrips, *Physothrips eucharii.*

Considerable interest has been displayed in the substitution of dusting for spraying, especially in the control of celery, onion, and potato diseases. Demonstrations of this method gave promising results in the case of celery blight [*Septoria apii*].

EASTHAM (J. W.). **Plant-disease survey of central B.C.**—*Agric. Journ. Brit. Columbia*, viii, 10, pp. 224–225, 233, 2 figs., 1923.

During the latter part of August [1923] the potato crop in the potato-growing sections of central British Columbia was inspected for health and suitability for use as seed with, on the whole, very encouraging results. The soil conditions, particularly in the western area, are extremely well adapted to potato cultivation, and the crops were practically free from leaf roll and mosaic. Common scab [*Actinomyces scabies*] was prevalent on heavy soils, and blackleg [*Bacillus atrosepticus*] occurred to the extent of 15 to 20 per cent. at Fraser Lake and eastwards. Powdery scab [*Spongospora subterranea*] and late blight [*Phytophthora infestans*] were altogether absent, while early blight [*Alternaria solani*] and *Fusarium* wilt were negligible.

The grain crops inspected in the same district were excellent, especially the oats. Presumably owing to the complete absence of the common barberry (*Berberis vulgaris*), the incidence of stem rust of wheat [*Puccinia graminis*] was exceedingly slight. A certain amount of oat smut [*Ustilago avenae*], due to neglect of proper seed disinfection, was observed.

The fruit crops also enjoyed remarkable immunity from insect pests and fungous diseases.

VOGLINO (P.). **I funghi più dannosi alle piante coltivate osservati nella Provincia di Torino e regioni vicine nel 1921.** [The fungi most injurious to cultivated plants observed in the province of Turin and the vicinity in 1921.]—*Ann. R. Acad. Agric. Torino*, lxv (1922), pp. 53–64, 1923.

Amongst the plant diseases observed in the province of Turin during 1921, in which the spring was particularly favourable for the development of various parasitic fungi, the following may be mentioned.

Potatoes were attacked by early and late blights (*Alternaria*

solani and *Phytophthora infestans*), the latter to a very slight degree, though it was severe on tomatoes. *Bacterium solanacearum* caused injury to the tubers in some of the mountainous areas, while the condition known as 'black heart' [see this *Review*, iii, p. 145] was observed in tubers stored without sufficient ventilation.

Peaches and plums were heavily infected by crown gall (*Bacterium tumefaciens*), the former to an extent which interfered seriously with their cultivation. *Clasterosporium carpophilum* caused gummosis, irregular growth, premature defoliation, and withering of the shoots of peaches and cherries. Peach leaf curl (*Exoascus deformans*) was particularly severe on the succulent growth, especially in localities exposed to sudden alternations of temperature. Excellent effects were produced by the application of a dormant spray of 3 per cent. Bordeaux mixture. Peach branches were also attacked by *Ascospora beijerinckii* under the same conditions of abrupt temperature changes as favoured leaf curl. American gooseberry mildew (*Sphaerotheca mors-uvae*) was prevalent in one locality, and *Sphaerotheca pannosa* was found on young shoots of peach and almond trees. Stored apples suffered frequently from the attack of *Sphaeropsis malorum*, which caused a stringy rot and rusty appearance of the fruit. A severe storage rot of apples was also caused by *Trichothecium roseum*, especially where the fruit had been previously damaged by scab (*Venturia inaequalis*) and codling moth. *Gymnosporangium sabinae* was found on both the alternate hosts, juniper and pear.

Septoria limonum caused the development of yellowish-white spots on the leaves of lemons under glass, and *Colletotrichum gloeosporioides* attacked lemon fruits.

Climatic conditions were favourable to infection by vine mildew (*Plasmopara viticola*) in the early part of the season. The production of sporangia began on 12th to 15th April, but favourable conditions for the liberation and germination of the zoospores were not experienced until the 28th or 29th April. The first attacks on the leaves were noticed on 16th to 17th May, and gave rise to sporangia on 23rd to 25th of the month. Weather conditions during the latter half of May and all through June continued to be favourable for the development of the disease, which was finally arrested by high temperatures in the latter part of July and during August. *Oidium* [*Uncinula necator*] attacked the leaves and shoots in August. American vines were severely damaged by *Rosellinia necatrix* where excessive quantities of organic manure had been given. Clinton vines were infected by *Bacillus ampelopsorae*, which attacked the branches.

Certain varieties of wheat suffered from the disease caused by *Gibberella saubinetii*, the symptoms of which are described. Flour prepared from wheat with 10 to 30 per cent. of infection was dark in colour and had an unpleasant smell. Wheat bunt (*Tilletia levis*) occurred in all districts where seed disinfection was neglected. *Ustilago* [*Sphacelotheca*] *sorghi* was found on sorghum. *Septoria graminum* was responsible for a wheat disease characterized by the yellowing and desiccation of the plants, which in some cases were not worth harvesting except for fodder. *Sclerotinia trifoliorum*

attacked several varieties of clover, causing the death of the affected plants.

French beans and beet were infected by rust (*Uromyces appendiculatus* and *U. betae* respectively) in August. Bean anthracnose (*Colletotrichum lindemuthianum*) was favoured by the rain and high temperature of the early part of September. Garlic was heavily attacked during May by *Sclerotium cepivorum* and winter lettuce and chicory by *Bremia lactucae.*

Pythium de Baryanum caused a black discoloration of the roots, followed by death, in seedlings of the drug plants *Salvia sclarea* and *Satureia hortensis.* A serious disease of *Lobelia erinus* occurred in the municipal gardens of Turin. The base of the stem was covered with a fine, greyish mycelium, in which developed hard, black, wrinkled, round or elliptical sclerotia, up to 6 or 7 mm. long by 4 to 5 broad. On germination these produced conidial fructifications like *Botrytis cinerea*, but apothecia were not developed. The fungus is provisionally referred to *Sclerotinia libertiana.* Hydrangeas were attacked by *Phyllosticta hydrangeae,* carnations by *Septoria dianthi,* and *Dianthus carthusianorum* by *Puccinia arenariae.*

Walnuts suffered severely from *Gnomonia juglandis,* which almost completely defoliated several trees by the end of May. The low temperature in the spring favoured several tree diseases, especially *Gloeosporium nervisequum* on plane trees [*Platanus*], which caused a marked black discoloration along the veins of the leaves. *Gloeosporium elasticae* [*Glomerella cingulata*] was found on *Ficus elastica,* and *Melampsoridium carpini* on the hornbeam [*Carpinus betulus*].

PAINE (S. G.) & BEWLEY (W. F.). **Studies in Bacteriosis. VIII. Further investigations of the 'stripe' disease of Tomato.**—*Ann. of Appl. Biol.*, x, 1, pp. 89–95, 1923.

The organism causing stripe disease of tomatoes was identified by the authors in 1919 as *Bacillus lathyri*, and the results are now published of inoculations with isolations from tomato on various other plants, chiefly legumes. Inoculations through punctures in the base of the stem were successful on peas, lupins, red clover (*Trifolium sativum*), *Onobrychis sativa*, and potato. Inoculations of the seed by soaking in a water suspension of the bacteria succeeded with peas and red clover only. Peas, red clover, broad beans (*Vicia faba*), vetch (*Vicia sativa*), French beans (*Phaseolus vulgaris*), sweet pea (*Lathyrus sativus*), lucerne, lupins, and *Onobrychis sativa* were all infected when inoculated by spraying with water suspensions of the bacteria.

Some evidence was obtained that tomato stripe is at times carried by the seed. Suitable dressings with potash were found to increase the resistance of tomatoes to this disease. Streak disease of broad beans and garden peas has been observed in an allotment which had received the scrapings from tomato houses mixed with old cucumber soil. The symptoms of the disease on these two hosts are briefly described.

PAINE (S. G.) & LACEY (MARGARET S.). **Studies in bacteriosis. IX. 'Streak disease of Broad Beans'.**—*Ann. of Appl. Biol.*, x, 2, pp. 194–203, 3 pl., 1923.

The streak disease of broad beans due to *Bacillus lathyri*, the symptoms of which [see this *Review*, ii, p. 99] are fully described, caused losses estimated at 40 to 50 per cent. of the total crop in the south of England in 1920.

Full details are given of the authors' inoculation experiments which demonstrated that the causal organism is the same as that responsible for the stripe disease of tomatoes and streak disease of sweet peas and other legumes. The organism is rapidly killed by drying. Spread is believed to take place largely by wind currents, but aphids and other insects probably assist. Seeds bored by *Bruchus rufomanus* were found to be infested with *B. lathyri* and, on planting, many of those that germinated gave streaked plants.

Control measures on the lines of those mentioned in the authors' previous paper are recommended.

PAINE (S. G.) & LACEY (MARGARET S.). **Studies in bacteriosis. X. 'The use of serum-agglutination in the diagnosis of plant parasites'.**—*Ann. of Appl. Biol.*, x, 2, pp. 204–209, 1923.

The authors have applied serum agglutination tests, using rabbit sera collected after inoculation with the organisms to be tested, to various yellow bacteria found in association with *Bacillus lathyri* in the stripe disease of tomatoes and streak disease of beans [see this *Review*, ii, pp. 99, 347, and last abstract], in order to determine their relationship with this organism. One of these gave all the reactions of *Pseudomonas phaseoli*, with which it is considered to be identical, though it is superficially like *B. lathyri*. Both it and *B. lathyri* seem to be susceptible to group agglutination (the latter being agglutinated with the serum of the former) and the same applies to forms intermediate between the two organisms. Hence it is suggested that one species may have arisen in the plant tissues as a mutant from the other. A similar consideration may account for the fact, familiar to plant pathologists, that on plating from diseased tissues few of the resulting colonies, though apparently of the same organism, possess any virulence for the host plant, the non-virulant forms being possibly mutants of the virulent one. *Aplanobacter dissimulans*, which is also often associated with *B. lathyri*, is an entirely distinct form and showed no agglutination with sera prepared from the other two organisms.

WOLF (F. A.). **Studies on the physiology of some plant pathogenic bacteria; VII. Pectic fermentation in culture media containing pectin.**—*Phytopath.*, xiii, 9, pp. 381–384, 1923.

In order to investigate the secretion of pectin enzymes by certain bacteria and fungi, the author prepared culture media containing pectin. A commercial pectin product named 'Certo' was used to prepare relatively pure pectin by precipitation with an equal volume of 95 per cent. alcohol and subsequent purification. One per cent. by weight of the purified powdered pectin was then added to bacto-agar containing 18 gm. bacto-agar to 100 c.c. of water or to plain

bouillon containing 1 per cent. Difco peptone, 0·3 per cent. Liebig's beef extract, and 0·5 per cent. NaCl, the reaction being adjusted to P_H 7·4 and phenol red being added to the agar medium as an indicator. After 48 hours' incubation the media were inoculated with *Bacillus carotovorus, Bacterium tabacum, Bact. angulatum, Bact. sojae,* and *Bact. campestre.*

The most vigorous fermentative action in pectin bouillon was exhibited by *Bact. carotovorus,* which changed the reaction from P_H 7·4 to P_H 5·4 in three days and to P_H 5·2 in five days. *Bact. campestre* gave a P_H value of 6·8 in three days and 6·0 in seven days, while the others were less active, especially *Bact. sojae* (6·8 in 7 days). This increase in acidity is stated to be due to the fermentation of pectin. In pectin agar containing phenol red the colour had all disappeared, in stab cultures of *Bact. carotovorus,* within three days. By the seventh day the colour had disappeared in cultures of *Bact. campestre,* and pronounced changes had taken place in the cultures of *Bact. tabacum* and *Bact. angulatum,* whereas the alteration in *Bact. sojae* was very slight. The rate of the disappearance of colour in the solid medium thus corresponded with the intensity of fermentation as measured by P_H values in the liquid cultures.

This quantitative method of estimating the activity of pectin enzymes is believed to be of value in detecting the relatively weak pectin decomposition exhibited by many organisms producing diseases of the leaf spot type.

KENDRICK (J. B.) & GARDNER (M. W.). **A simple method of determining the thermal death-point.**—*Proc. Indiana Acad. Science 1922,* pp. 257–258, 1 fig., 1923. [Received 1924.]

In recent studies of the thermal death-points of certain bacteria causing plant diseases, some modifications of the older methods have been adopted and are here briefly described. The chief features of the revised process consist in the use of water suspensions in small test-tubes, a large wooden container for the water bath in which the temperature is raised by the addition of steam or hot water, a cork float to support the tube and the thermometer, and the test of viability by making transfers to agar slants.

NEGRETTI (A. N.). **Tratamientos contra las enfermedades del Cacao.** [Treatment of Cacao diseases.]—*Rev. de Agric. Republica Dominicana,* xvii, 12, pp. 188–192, 1923.

A root disease of cacao, which causes considerable damage in the Moca and La Viga districts, Dominican Republic, and is due to *Rosellinia pepo,* is described. The attacks originate from dead and rotting stumps in forest clearings and rapidly extend to the roots of living plants in the neighbourhood, infection occurring chiefly through wounds. The fungus is also found on stumps of cacao plants cut down during thinning operations.

To prevent the disease, it is necessary to remove and burn all stumps and dead plant parts, to drain the soil well, and to leave plenty of room between the trees for air and ventilation. As soon as the first symptoms of the disease appear, the affected plants

should be carefully removed with as much of their root system as possible, and burnt, and the diseased area trenched round and thoroughly disinfected with quicklime or sulphate of iron. If quicklime is not available slaked lime is recommended. The trenches should be deep enough to cut through the roots, the object being complete isolation of the diseased area.

Schaffnit (E.) & Rump (L.). **Beobachtungen über Rostkrankheiten des Getreides.** [Observations on the rust diseases of cereals.]—*Mitt. deutsch. Landw.-Gesellsch.*, xxxviii, 49, pp. 624–628, & 50, pp. 639–642, 1923.

The authors' protracted investigations in the Rhine Provinces of cereal rusts, particularly yellow rust (*Puccinia glumarum*), are described, and a general account of these diseases is given.

Black rust (*Puccinia graminis*) does not often occur to any noticeable extent in the Rhenish districts. Some observations were made near Cologne in 1915–1916 on the effect of various fertilizers on the disease. Rock salt (300 kg. per hect.) gave the best results, followed by basic slag (600 kg. per hect.) with or without the addition of potassium nitrate and ammonium sulphate, and lime (3,000 kg. per hect.). The incidence of the disease was highest in the plots treated with gypsum.

The results of an extended series of tests [particulars of which are given] showed that the varieties Mette's Rauhweizen and Krafft's improved Siegerländer Landweizen combine immunity from yellow rust with prolific yields. Lists are also given of varieties fairly resistant and susceptible to this disease, the former including von Arnim's Criewener 104 and the latter Strube's Squarehead. Negative results were obtained in all experiments in the control of yellow rust by means of fertilizers.

Sax (K.). **The relation between chromosome number, morphological characters and rust resistance in segregates of partially sterile Wheat hybrids.**—*Genetics*, viii, 4, pp. 301–321, 1923.

The relations between chromosome number, morphological characters, and rust resistance were determined for F_3 segregates of *Triticum vulgare* × *T. durum* (Amby × Kubanka) at Orono, Maine, in 1922, the data on rust resistance being obtained in the field. Climatic conditions were very favourable for rust, and susceptible varieties were severely infected by *Puccinia graminis*. In the author's cultures einkorn was highly resistant, Kubanka moderately so, while Marquis and a club variety resembling Little Club were extremely susceptible.

In the experiments a scale of rust resistance was adopted similar to that used by previous investigators. A very high degree of correlation was found to exist between chromosome number, rust resistance, and other morphological and physiological characters. *T. vulgare* is known to have 21 gametic chromosomes and *T. durum* 14. In the F_3 segregates from the cross the great majority have either 14 or 21 chromosomes, most of the intermediates being eliminated through sterility in the F_1 and subsequent generations. Plants with 14 chromosomes resembled the resistant *durum* parent,

while those with 21 chromosomes showed the morphological characters and susceptibility to rust of the *vulgare* parent. As the chromosome number increases from the highly resistant einkorn with 7 haploid chromosomes to the 14 of emmer and 21 of common wheat susceptibility to disease is augmented. At the same time the variability and adaptability of the species, together with its economic value, are increased. But the crosses with intermediate numbers of chromosomes tend to be eliminated because of their sterility: and it appears to be very unlikely that the desirable qualities of, say, emmer and common wheat can be combined in a homozygous condition. The author is not aware of any instance in which this has been successfully accomplished.

Generally speaking, resistance to rust and bunt [*Tilletia tritici* and *T. levis*] appears to depend on the same physiological factor or factors. It is probable that the rust-resistant varieties of the middle west would prove equally resistant to bunt on the Pacific coast, and vice versa.

The breeding of wheat varieties to combine disease resistance with high yield and quality of grain is stated to have much greater prospects of success if the parents are selected within the *vulgare* group.

HUME (A. N.) & EVANS (A. T.). **Some experiments with spring Wheat in South Dakota.**—*South Dakota Agric. Exper. Stat. Bull.* 201, pp. 518–559, 1923.

During the past few years the wheat production of South Dakota has declined by several hundred thousand bushels owing to the increasing prevalence and destructiveness of black rust (*Puccinia graminis*) and scab (*Gibberella saubinetii*). At present Kota S.D. 1184 gives the greatest promise of rust resistance and may gradually be used to replace Marquis which appears to be losing its former resistance. D–5, a red durum, is highly resistant to rust, but little cultivated on account of its poor milling qualities. Several new varieties of Canadian wheat, including Prelude, Ruby, Red Bobs, and Kitchener, have been introduced into South Dakota, where it is hoped that their early maturity will ensure freedom from rust.

In a test on the comparative efficiency of formaldehyde and copper carbonate in the control of wheat bunt [*Tilletia tritici*], the former reduced germination so much that the plot had to be reseeded, while the latter not only completely prevented the development of infection but also stimulated germination. Copper carbonate is economical as well as efficacious, being purchasable at a cost of 25 to 30 cents per lb.

A four-year rotation of maize, oats, wheat, and legumes is recommended for the control of scab.

ATANASOFF (D.). **Fusarium blight of the cereal crops.**—*Meded. Landbouwhoogeschool, Wageningen,* xxvii, 4, 132 pp., 6 pl., 1923. [Dutch summary.]

In this paper a very full account is given of the present position of knowledge regarding the cereal diseases caused by fungi belonging to the genus *Fusarium*. These diseases, which the

author states are all identical in their symptoms and pathological effects, have not hitherto attracted much attention in Europe, though they are economically very important in many European countries. Wheat, barley, oats, and rye are all attacked, as well as many grasses; seedling blight, foot rot, leaf spotting, node rot, and ear blight or scab can all be produced by each of the several parasites. Even the type of disease known as 'snow mould' in Germany and Scandinavia, and usually attributed to *F. nivale* (*Calonectria graminicola*), can be caused by several species. Each form of attack results from independent infection, the author being wholly opposed to the view that systemic infection of the type described by Doyer [see this *Review*, i, p. 56] can occur.

The life-histories of the cereal species of *Fusarium* are not yet fully known, but are believed to be, in general, the same as that of the conidial stage of *Gibberella saubinetii*, which has been fairly fully followed out and is given in detail. The symptoms of each form of the disease are also described, together with the influence of climate and other factors on its development. Much of this part of the work is based on the author's own studies, carried out during a period of six years in the United States, Bulgaria, Germany, and Holland.

All the species described have been studied in pure culture, hard oat-meal agar proving the best of the media tried, except for the production of perithecia in the perfect forms, for which stems of *Melilotus alba* or green bean pods are to be preferred. The perithecia are usually formed in nature only after successful parasitic growth and free conidial development. In culture they are usually produced only in subcultures from 'normal' conidial cultures in the sense used by Appel and Wollenweber [*Arb. K. Biol. Anst. Land- u. Forstwirtsch.*, viii, 1910], the subcultures being kept uniformly moist; contamination with an unidentified bacterium greatly aided their formation and also that of the conidia of *G. saubinetii*. Numerous inoculations, which are briefly described, were successfully carried out with the various species.

In the systematic section the following species of cereal parasites are described, the synonymy, diagnosis in English, habitat, and pathogenicity of each being given:—*Gibberella saubinetii* (Mont.) Sacc. (*Fusarium graminearum* Schwabe, *F. roseum* auc., &c.); *Calonectria graminicola* (B. & Br.) Wr. (*F. minimum* Fcl, *F. nivale* Sor. p.p., &c.); *Fusarium culmorum* (W. G. Sm.) Sacc. (*F. versicolor* Sacc., *F. rubiginosum* App. & Wr. &c.) and its var. *leteius* Sherb.; *F. avenaceum* (Fr.) Sacc. (*F. diffusum* Carm., *F. subulatum* App. & Wr., *F. lucidum* Sherb., &c.); *F. herbarum* (Cda) Fr. (*F. amenti* Rostr., *F. pirinum* (Fr.) Rostr., *F. putrefaciens* Osterw., *F. sorghi* Henn., *F. metachroum* App. & Wr., &c.); *F. arcuosporum* Sherb.; *F. scirpi* Lamb. & Fautr. (*F. gibbosum* App. & Wr., &c.); *F. redolens* Wr. (*F. vasinfectum* Atk. var. *pisi* Van Hall); *F. solani* (Mart. p.p.) App. & Wr. var. *cyanum* Sherb.; and *F. arthrosporioides* Sherb.

The methods of control of these diseases and the behaviour of cereal varieties to infection are briefly discussed. There is a very full survey of the literature, and the paper terminates with a bibliography of 295 titles.

BABOWITZ (K.). **Ratgeber zur Sortenwahl. Sortenversuchsergebnisse mit Wintergerste, Winterroggen und Winterweizen. Versuchsjahr 1921–22.** [Advice on the choice of varieties. Results of selection experiments in 1921–22 with winter Barley, Rye, and Wheat.]—*Arb. deutsch. Landw.-Gesellsch.*, 325, 54 pp., 1923.

This comprehensive survey of the varietal selection work of the German Agricultural Society during 1921–22 contains much useful information on the productivity, disease resistance, and other important characters of the principal varieties of winter cereals in Germany.

Hörning's barley was particularly susceptible to stripe disease [*Helminthosporium gramineum*] and loose smut [*Ustilago nuda*], the latter attacking also Streng's and Ackermann's Viktoria.

Pirna rye was extremely susceptible to flag smut [*Urocystis occulta*] and Schickert's Pfälzer, Niederarnbacher, Kirsches, Döbelner, and Bohnstedt's Benauer somewhat liable.

Bunt of wheat [*Tilletia tritici* and *T. levis*] was particularly severe on Rippiener and Frankenthaler Brown Squarehead, the former of which was also susceptible to rust and the latter to loose smut [*U. tritici*]. Criewener 104, Friedrichswerther Berg Gold, Saxonia Dividenden, and Saxonia Prinzen were also attacked by bunt, and the two former, with Klädener Altmärkischer, by loose smut.

DIETZ (S. M.). **The rôle of the genus Rhamnus in the dissemination of crown rust.**—*U.S. Dept. of Agric. Bull.* 1162, 18 pp., 8 figs., 1923.

Buckthorn (*Rhamnus cathartica*) has long been used as an ornamental shrub in the United States and occurs as an escape from cultivation throughout the north-central and north-eastern districts. It commonly bears aecidia of crown rust (*Puccinia coronata* [*P. lolii*]) and has been observed to start severe epidemics of rust in Iowa, Wisconsin, Minnesota, and Illinois.

At Hinton, Iowa, the incidence of infection in fields adjoining a hedge of buckthorn was so heavy in 1921 that the crops were not even harvested. The first pycnidia appeared on the *Rhamnus* leaves on 13th May, and aecidiospores were present in great numbers by the 17th. On the 22nd the first uredosori were observed on the oats within 70 ft. of the hedge. Previous to this date no crown rust had been found within forty miles of the farm in question. Oat fields 170 rods distant were soon infected, though separated from the *Rhamnus* hedge by fields of maize, alfalfa, clover, and barley. Oats at a distance of nearly 1½ miles became infected in 7 days (before the first uredospores were ripe), the incidence of the disease decreasing progressively with the distance from the hedge. The weather conditions prevailing during the period of maximum aecidiospore production were favourable to the dissemination and germination of the spores. The mean temperature (71° F.) was 8·6° F. above the normal for the period, while the average humidity was also high (70·6 per cent.). Of the grasses growing near the *Rhamnus* hedge, only timothy (*Phleum pratense*) showed slight symptoms of infection. The spread of the disease was very rapid

after the first generation of uredospores matured, oats being infected at a maximum distance of 53 miles from the hedge within a fortnight.

Only one case (at Indianala, Iowa, in 1919) is known to the writer in which aecidia from the widely distributed *Rhamnus lanceolata*, which bears them every year, were responsible for an initial infection of crown rust of oats. Aecidiospores collected on *R. lanceolata* were capable of infecting *Phleum pratense, Calamagrostis canadensis, Agrostis hiemalis,* and *Festuca elatior* under field conditions. In the extreme south of Iowa crown rust appears to hibernate in the mycelial or uredospore condition, uredospore infection having been found on oats prior to aecidial infection on *R. lanceolata*.

R. caroliniana extends eastward from Texas, Kansas, and Missouri to the Atlantic coast. Apparently it does not bear aecidiospores every year, but in recent greenhouse experiments they were produced when it was exposed to infection by teleutospores from oats. *R. alnifolia*, a native northern species, bears heavy aecidiospore infection of crown rust when growing near *Calamagrostis canadensis*. Although it has been found to assist the spread of crown rust to the latter, it does not seem to be concerned in the dissemination of the specialized form of *P. coronata* on oats.

R. frangula, *R. smithii*, *R. purshiana*, *R. californica*, and *R. crocea* are relatively unimportant in the dissemination of crown rust, being limited in distribution and not usually grown in proximity to oats. Under field conditions *R. smithii* and *R. purshiana* bear aecidia, and grasses growing near the former species become infected.

Talieff (V. I.) & Grigorovitch (A. I.). К влиянию головни на растение-хозяина. [On the influence of smut on the host plant.]—*Trans. Myc. & Phytopath. Sect. Russian Bot. Soc., I, Trans. Moscow Branch*, pp. 47–53, 1923. [French Summary.]

As the result of observations and measurements carried out in 1921 on a limited number of infected and healthy plants of *Avena ludoviciana*, a species of oats highly susceptible to *Ustilago avenae*, the authors state that under the influence of this fungus the plants become considerably more bushy than normal. The number of stalks in healthy plants ranged between 3 and 22, while it was from 7 to 37 in diseased ones. On the other hand, the height and diameter of the stalks were noticeably reduced in the infected plants, as was also the weight of the entire air-dried stool, the ratio of reduction being from 41·2 in healthy to 38·2 in diseased plants. The authors believe that the greater bushiness of the infected plants is probably due to the suppression of flowering caused by the fungus.

Zade (A.). **Die Anfälligkeit unserer Winterweizensorten gegenüber dem Steinbrand.** [The susceptibility of our winter Wheat varieties to bunt.]—*Mitt. deutsch. Landw.-Gesellsch.*, xxxviii, 52, pp. 666–667, 1923.

The results of four years' experimental study of the reaction to bunt of wheat [*Tilletia tritici* and *T. levis*] of 56 winter wheat

varieties in Germany, the seed of which was heavily dusted with spores, showed Heil's Squarehead to be practically immune. A fair degree of resistance was exhibited also by strain 53 of the Pomeranian Seed Company, and by Kirsche's Squarehead.

Coons (G. H.). **Copper dust successful against stinking smut.**—*Quart. Bull. Michigan Agric. Exper. Stat.*, vi, 1, pp. 1–8, 1 fig., 1923.

Excellent results are stated to have been again obtained [see this *Review*, ii, p. 73] in the 1923 tests with copper carbonate dust (2 oz. per bushel) for the control of bunt (*Tilletia levis*) on Red Rock wheat. The proportion of infection from heavily contaminated seed was reduced from 26 per cent. in the untreated rows to 1 per cent. in those treated with the dust. Full directions for the treatment are given. Immersion in 1 pint commercial solution of formaldehyde to 40 galls. water and skimming off the unbroken bunt balls gave complete control, as did also a sprinkling with the same solution; the 'dry' formaldehyde treatment [see this *Review*, i, p. 436], however, was less effective (3 per cent. bunted). Copper sulphate and lime dust (2 oz. per bushel) reduced the infection to 2·5 per cent. A copper carbonate dust containing gypsum and analysing 18 per cent. of copper gave as good results as a pure copper carbonate dust analysing 48 per cent. copper. The grain can be treated at any time and sown at any time.

Ausborn. **Das Beizen der Wintergerste.** [The disinfection of winter Barley.]—*Deutsche landw. Presse,* l, 35, p. 304, 1923.

Stripe disease of barley (*Helminthosporium gramineum*) may be controlled by one hour's immersion of the seed in germisan (0·25 per cent.) or uspulun (0·5 per cent.). Immersion of the seed (previously soaked for four to six hours) in water at 50° to 52° C. for ten minutes is also efficient and simultaneously controls loose smut [*Ustilago nuda*], which cannot be combated by any other means. The writer adopted this method with small quantities of infected winter barley with very satisfactory results, stripe disease being entirely eliminated and loose smut very greatly reduced. In two plots of 32 sq. m. each, the untreated seed gave 266 smutted plants and the treated 54, while the incidence of *H. gramineum* in the same area was reduced from 688 plants to nil. The incomplete control of smut was due to the fact that the temperature of the water was kept slightly under 52° C., in order to prevent risk of injury to germination which frequently accompanies immersion at higher temperatures.

Müller (H. C.), Molz (E.), & Müller (K.). **Ueber die technische gleichzeitige Bekämpfung von Keimlings- und Blüteninfektionskrankheiten des Getreide-Saatgutes.** [On the practically simultaneous control of seedling and blossom infection diseases of cereal seed.]—*Deutsche landw. Presse,* l, 37, p. 319, 1923.

During the period 1921 to 1923 experiments were undertaken at

Halle to test the possibility of combining the methods used for the prevention of seedling infection and blossom infection, respectively, of cereals with certain well-known parasites.

In 1921–22 winter barley infected with stripe disease [*Helminthosporium gramineum*] was treated by the method recognized as successful in the control of loose smut of barley [*Ustilago nuda*], i.e., immersion of the seed for ten minutes in water heated to 52° C., after presoaking for four to six hours at ordinary temperature. The results of the tests showed that the method was unreliable and inadequate when applied to stripe disease.

Good results were obtained in the control of loose smut by immersion of the seed in uspulun or germisan (0·125 per cent.) at ordinary temperature for four hours, followed by a ten minutes' dip in water at 52° C.

In 1922–23 bunt of wheat [*Tilletia tritici*] was successfully controlled by immersion of the seed for four hours in 0·125 per cent. germisan, kalimat, or formalin, or 0·125 to 0·250 per cent. uspulun, followed by a ten minutes' dip in water at 52° C.

Hence a combined treatment against bunt and loose smut [*Ustilago tritici*] of wheat is evidently possible.

GREGORY (C. T.). **The present status of the hot water treatment in Indiana.**—*Proc. Indiana Acad. Science 1922*, pp. 315–318, 1923. [Received 1924.]

There has been a steady increase in the use of the hot water treatment of wheat for the control of loose smut [*Ustilago tritici*] since 1917, when the method was first tested in Indiana. The influence of the treatment has been strongly felt in the constantly increasing supply of seed from treated fields.

Under various headings the writer briefly discusses the modifications in the application of the treatment which have been found necessary to augment its efficiency. These include, *inter alia*, the presoaking of the seed for only four, instead of eight or twelve, hours; the invention of various devices to facilitate the operations; and the drying of the seed after treatment.

The stands of treated wheat are usually thin, but the heads are more uniform in size and often larger than those of untreated plants. Treated wheat generally ripens about a week later than untreated, and this delay in ripening may occasionally prove a serious drawback, owing to the longer exposure of the plants to unfavourable weather conditions.

It has been clearly shown that the best way of dealing with the smut problem is to establish smut-free areas, and arrangements are in progress for placing the work of treatment in the hands of the farmers themselves. In one county it was found that wheat treated the previous year had no smut, while that treated two and three years earlier had 0·25 per cent. and 2 per cent. respectively. This demonstrates the importance of a widespread use of seed from a treated crop. Enough seed is now being treated for whole fields, so that it will be much easier to keep this wheat separate and propagate smut-free seed.

Ducellier (L.). **L'ergot de l'Avoine en Algérie.** [Ergot of Oats in Algeria.]—*Bull. Soc. Hist. Nat. Afrique du Nord*, xiv, 7, pp. 290–293, 1923.

In continuation of the author's previous investigations [see this *Review*, i, p. 423] *Claviceps purpurea* has now been found producing ergot in the ears of *Avena sterilis* in Algeria as well as in several cultivated varieties of common oats [*A. sativa*] and Algerian oats [*A. algeriensis*]. The ergot of *A. sterilis* differs little from that of oats, but may vary from 5 to 20 mm. in length and two may sometimes be developed on a single spikelet. Its presence on this grass greatly increases the risk of infection to oats, since *A. sterilis* is difficult to eradicate and its sclerotia are readily shed with the spikelets before the cultivated crop ripens.

So far ergot has not been found on *A. barbata* nor on the cultivated cereals other than oats in Algeria.

Bredemann (G.). **Die Bestimmung des Brandsporengehaltes von Weizenproben.** [The determination of the bunt spore content of Wheat samples.]—*Zeitschr. für Untersuch. der Nahrungs- und Genussmittel*, xlv, 4, pp. 208–209, 1923.

The author states that his method for the quantitative determination of the percentage by weight of the spores of wheat bunt (*Tilletia tritici* and *T. levis*) in samples of flour, bran, and the like (*Landw. Versuchsstat.*, lxxv, p. 135, 1911) has consistently given reliable results when carefully carried out. The reported failures (e. g., *Mitt. biol. Reichsanst.*, xxi, p. 45, 1921) are due to neglect to pulverize the fragments of husk, &c., sufficiently to pass through a 0·3 mm. mesh sieve. The method can also be used to determine the amount of bunt contamination in wheat grain samples.

Durrell (L. W.). **Dry rot of Corn.**—*Iowa Agric. Exper. Stat. Res. Bull.* 77, pp. 347–376, 3 col. pl., 10 figs., 3 diag., 1923. [Received 1924.]

The symptoms of the dry rot of maize caused by *Diplodia zeae* [see this *Review*, ii, p. 213] are very fully described in this bulletin. The attack takes place principally through the nodes and ear shanks, though the 'silk' and tips of the ears may also afford entry. At the time of flowering the leaf sheaths become loosened from the stalk, and spores and moisture lodge in the cavities thus formed. The infection is local, not systemic, and is not transmissible by the seed except as a result of external contamination.

Moisture is the determining factor in the growth of the fungus, and observations made during 1921 and 1922 indicate that August is the critical month for the disease in Iowa. Even a heavy rainfall in the earlier part of the season does not always result in an epidemic, apparently because a maximum of stored food in the plant, the cessation of rapid tissue growth, and the loosening of the leaf sheaths are also necessary factors in the onset of the disease.

The minimum temperature for the growth of *D. zeae* was found to be between 10° and 15° C., the maximum between 35° and 40°, and the optimum between 28° and 30°. The optimum temperature

for the growth of maize is stated to be 34° C. The relation of soil temperature to *Diplodia* infection is not very direct, the average of the former for Iowa during the maize-planting season being near the minimum for the growth of the fungus.

It was found that *D. zeae* was incapable of growth in the absence of oxygen, a fact of interest in regard to the relation of the fungus to ensilage, which is cured under anerobic conditions.

The fungus grows vigorously on a number of media. It appears to produce lipase, erepsin, amidase, sucrase, maltase, invertase, cytase, and possibly trypsin and amylase. Its utilization of cellulose assists its penetration into and growth within the stalk and results in the weakening of the nodes. The survival of the organism in old stubble and trash appears probable, and a saprophytic life in the soil is also likely since it grows on soil containing organic matter.

The recommendations for the control of the disease are a four or five year system of rotation, early field seed selection, and seed germination before planting.

Holbert (J. R.), Burlison (W. L.), Biggar (H. H.), Koehler (B.), Dungan (G. H.), & Jenkins (M. T.). **Early vigor of Maize plants and yield of grain as influenced by the Corn root, stalk and ear rot diseases.**—*Journ. Agric. Res.*, xxiii, 8, pp. 583–630, 7 pl., 20 graphs, 1923.

The present paper is an exhaustive report on investigations conducted during the period from 1918 to 1921 at several experimental stations in Illinois. Approximately 153,000 maize seedlings raised from diseased and relatively disease-free seeds and transplanted from the germinator to the field were examined; of this number over 6,000 were studied individually and the yield of grain per plant determined.

During the early stages of growth the seedlings were classified as vigorous, semi-vigorous, and weak. In the first 25 days from transplantation the disease-free seedlings grew more rapidly than those from diseased seed, both in height and diameter. *Gibberella saubinetii* appears to have been the organism chiefly concerned, but *Diplodia* [*zeae*] and *Fusarium* are also mentioned. Early height and yield of the plants were found to be correlated directly, and in most cases the coefficient of correlation was high enough to be significant. Plants strong and vigorous from the start produced a larger percentage of good-sized ears and matured their grain somewhat earlier than the weaker ones, regardless of height at harvest time. Plants weak at their early stages of growth usually produced imperfectly developed ears only, or were barren. Maize grown from seed not infected with or not susceptible to the root and stalk rot organisms contained a higher percentage of strong, vigorous plants, and produced higher total yields and higher yields of marketable grain, than maize raised under comparable conditions from infected or susceptible seed. Relatively disease-free seed ears selected from badly diseased plants proved to be inferior to similar ears selected from apparently disease-free plants, especially when the comparisons were made on infected soil. The germinator test

is not always conclusive as to the behaviour of a given lot of seed, as some types of maize are so susceptible that they prove to be very easily attacked when planted in infected soil after standing satisfactorily the germinator test. Maize resistant to root and stalk rots was found also to be resistant to ear rots. Maize earworms seem to show little preference for maize from diseased as compared with nearly disease-free seed within a variety, but the total injury to the latter is much less as the worm attack is not followed by ear rots to the same extent as in the former.

The authors conclude that variations in early vigour are due to certain genetic, physiological, and pathological factors which are more or less under the control of the investigator, the maize breeder, and the maize grower; the importance of the disease factor being such as to demand a prominent place in any attempts to effect a permanent improvement in the crop.

TSCHERMAK (E.). **Erfahrungen bezüglich Gelb-Rostbefalles bei frühschossendem Getreide.** [Experiments in the incidence of yellow rust with early ripening cereals.]—*Deutsche landw. Presse*, l, 38–39, pp. 327–328, 1923.

The author has made a series of observations on the incidence of yellow rust of wheat [*Puccinia glumarum*] on a number of varieties grown in Austria, Hungary, and Czecho-Slovakia, using a modification of Gassner's classification, in which the intensity of the attack was divided into 4 to 6 degrees, and the phases of development of the host plant into 4 or 5 stages.

Under the prevalent climatic conditions of these countries it was found that precocity of development is undoubtedly the decisive factor in infection by yellow rust, inherent varietal susceptibility being a purely secondary consideration. The results of observations extending over the last eight years have shown that the Bochum and most Hungarian varieties of winter wheat, which have a short period of development and a precocious maturity, are uniformly more susceptible to yellow rust than the slow-growing varieties, the same being true of rye. Hybrids of summer and winter wheats, sown in the autumn, developed rapidly in the spring and were severely attacked. *Aegilops ovata*, spring sowings of which are resistant to the disease, developed severe infection when sown in the autumn. *Triticum dicoccoides*, an early ripening species, showed much greater susceptibility than the late maturing *T. monococcum.* Other early ripening susceptible varieties are the summer purple-grained Abyssinians and the winter Bochara. In the author's opinion the best time for autumn sowing in the areas in question is the end of September or beginning of October.

The results of hybridization experiments between the early susceptible Bochara and late ripening varieties showed, in the F_1 generation, a prevalence of susceptibility in the plants ripening at an intermediate stage between early and late; in the F_2 generation segregation occurred, the early ripening individuals being severely and the late maturing ones only slightly attacked by the disease.

PELTIER (G. L.) & FREDERICH (W. J.). **Relative susceptibility of Citrus fruits and hybrids to Cladosporium citri Massee.**—*Journ. Agric. Res.*, xxiv, 11, pp. 955–959, 1923.

Citrus scab, stated to be caused by *Cladosporium citri*, occurs with some frequency in Alabama, where the authors have tested the susceptibility to it of species of citrus fruits and their hybrids.

None of the wild relatives of citrus tested except *Poncirus trifoliata* proved susceptible. Of the cultivated forms a list is given showing their relative susceptibility. The *C. sinensis* group of oranges is immune. In *C. grandis*, most of the common Florida grapefruits are only slightly susceptible, the Indian and Chinese pomelos are susceptible, and the Florida shaddock is very susceptible. Amongst *C. nobilis* varieties the incidence of scab appears to vary with the season, but the Cleopatra tangerine (which is fairly resistant to canker [*Pseudomonas citri*]) does not get scab. *C. mitis* and several of the oriental oranges are very susceptible.

WATTS (F.). **Withertip disease of Limes.**—*Rept. Agric. Dept. Dominica, 1922–23*, pp. 10–16, 1923. [Received 1924.]

Wither-tip of limes (*Colletotrichum gloeosporioides*) was first observed in Dominica on 8th May 1922, and from the first week in July till the beginning of October it spread throughout most of the island. The most severe attacks occurred in wet districts situated on rich humus soils at elevations exceeding 1,000 ft. Flowers, fruits, and young shoots were all greatly damaged, and the losses in the wet districts may be estimated at 80 to 90 per cent. of the second crop.

The symptoms of wither-tip on the flowers and fruit are unmistakable. The former turn brown and have a water soaked appearance, while the latter may have one or more black patches on the rind. In young limes these black patches become depressed, penetrating the fruit and causing it to fall before it reaches the size of a pea. Fruits which are not attacked until they reach the size of a large marble usually survive, the wound gradually healing and forming a light brown, wart-like prominence. Dark patches, subsequently turning pale, appear on the leaves, especially at the margins.

The following treatment, based on the results of experiments in Florida, is recommended. Bordeaux mixture (3–3–50) plus 1 per cent. oil [see below, p. 219] (1) as a clean-up spray just before the trees become active; (2) at the height of the flowering season; (3) about 30 days later. The following spraying programme has also been suggested in view of the heavy rainfall of Dominica: (1) as above; (2) when most of the petals have dropped; (3) as many subsequent applications at ten-day intervals as may be necessary to protect the fruit.

The cost of spraying materials per annum, allowing 3 galls. per tree for each of three applications, works out at \$9·72 per acre where the trees are planted 20 × 20 ft. apart. The cost of labour and the purchase and upkeep of apparatus must be added to this.

While spraying is recommended as a temporary measure, the substitution of new or resistant varieties for the susceptible ones

now in cultivation is regarded as offering the best prospect of permanent control.

PRETI (G.). **Osservazioni intorno ad una fumaggine della Bumelia ambigua Ten. e a quella degli Agrumi.** [Notes on a sooty mould of *Bumelia ambigua* Ten. and on that of Citrus.] —*Riv. Patol. Veg.*, xiii, 5–6, pp. 69–84, 1923.

Specimens of *Bumelia ambigua* Ten. (*B. lycioides* Wild.) in the Botanical Gardens of Portici and Naples were found to be covered by a sooty mould, the origin and development of which was studied. It seemed to be most prevalent on leaves and twigs on the south side of the plants. On the young leaves, particularly along the leaf veins, the scale insect *Saissetia oleae* becomes established in the spring after having overwintered on the older branches, and the fungus is visible about three weeks later, developing, no doubt, in the honeydew secreted by the insects. Under favourable climatic conditions the black crusts very soon cover the whole surface of the leaves.

Pure cultures, starting from ascospores, were obtained, and a detailed study of the morphology of the fungus in culture and on the host were carried out. Pycnidia developed in culture after 40 to 50 days. Perithecia were not formed in culture, but various conidial and chlamydospore forms of reproduction were given. Parallel cultures from the mycelium gave similar results. The forms of growth observed in these cultures and on the leaves were the following: (1) vegetative mycelial growth with conidia and chlamydospores (*Torula*, *Alternaria*, *Fumago*, and *Coniothecium* types); (2) sclerotial form; (3) pycnidial stage (*Asbolisia* Speg. and *Chaetasbolisia* Speg.); (4) perithecial stage. The fungus is considered to be identical with that described by Briosi and Passerini as *Apiosporium citri*, which is common on citrus trees. Its systematic position and relationship with other citrus sooty moulds are discussed. *Fumago camelliae* Catt. and *Meliola penzigi* Sacc. are stated to be the chief of these in Europe. Type specimens of all three forms were examined with the result that *M. penzigi* is considered to be the same as *A. citri*. *F. camelliae* attacks chiefly the leaves of *Camellia japonica*, but is said to occur also on citrus; it differs markedly from *A. citri*.

Notes are given on the principal characteristics of the two species, the correct nomenclature of which is considered to be *Limacinia citri* (Br. & Pass.) Sacc. and *Meliola camelliae* (Catt.) Sacc. and the synonymy as follows: (1) *Limacinia citri* (Briosi & Passerini) Saccardo. Syn. *Apiosporium citri* Br. & Pass., *Fumago citri* Catt., *Capnodium citri* Prill. p.p., *C. citri* Mont.; (?) *Morfea citri* Roze; *Meliola citri* Sacc.; *M. penzigi* Sacc.; *Dematium monophyllum* Risso; *Limacinia penzigi* Sacc.; *Pleosphaeria citri* Arnaud. p.p. (2) *Meliola camelliae* (Cattaneo) Saccardo. Syn. *Fumago camelliae* Catt.; (?) *Capnodium citri* Berk. & Desm.; *C. citri* Prill. p.p.; (?) *Morfea hesperidi* Roze; *Limacinia camelliae* Sacc.; *Pleosphaeria citri* Arnaud.

Outside Europe several other citrus sooty moulds have been described, some of which must be regarded as differing from the Italian forms.

Martinez (A. N.). **La Hemileia vastatrix del Café.** [*Hemileia vastatrix* on Coffee.]—*Circ. 15, Quinta Normal, Ambato* [*Ecuador*], 5 pp., 1923.

A detailed, semi-popular account is given of the coffee leaf disease caused by *Hemileia vastatrix,* which has so far not been recorded in Ecuador, though the author believes that a disease prevalent in the neighbouring republic of Colombia and attributed to physiological causes is, in fact, this disease. Prophylactic and therapeutic measures are discussed with a view to preparing for a possible invasion.

Garretsen (A. J.). **Engangs aangetast door een schimmel.** [Wasps attacked by a fungus.]—*De Thee*, iv, 3, pp. 91–92, 1 fig., 1923.

Isaria sphecophila has been found attacking wasps, which cause considerable trouble in Java tea plantations. In one instance *Helopeltis* was also infested. Owing to contamination by *Pestalozzia* it was impossible to obtain sufficient pure cultures to test the fungus as a possible means of control of these insects on a large scale, but it is hoped that this may be effected when further supplies are available.

Petch (T.). **Parasites of scale-insect fungi.**—*Trans. Brit. Mycol. Soc.*, viii, 4, pp. 206–212, 3 figs., 1923.

In this paper the author describes several parasites of fungi attacking scale insects. The first genus discussed is *Sirosphaera* Syd. (Sphaeropsideae), with globose-conoid pycnidia and minute, pale brown, continuous spores in chains, of which *S. botryosa* Syd. has been collected in Ceylon on *Pseudomicrocera henningsii*, which in turn was parasitic on a species of *Aonidia* living on *Memecylon*. Another species, *S. chlorostoma* n. sp., parasitizes a purple-red or purple-brown stroma which is common in Ceylon on species of *Aleyrodes*, but which it has not yet been possible to identify. Specimens were found on *Pavetta indica* and on *Streblus asper*. Another genus, *Sirosperma* Syd., differing from the foregoing only in lacking basidia and having hyaline spores, is represented in New Guinea by *S. hypocrellae* Syd. on a *Hypocrella* on *Imperata*, and in England by *S. sparsum* n. sp. on a *Cephalosporium* on *Lepidosaphes ulmi*, collected on hawthorn. Two new species of *Byssostilbe* Petch from Ceylon are recorded and described by the author: *B. fusca* on the stroma of *Torrubiella leuteorostrata* on an Aleyrodid on *Murraya exotica*, and *B. tomentosa* on *Cordyceps dipterigena* on *Mydaea* sp. on *Psychotria*. This genus differs in its perithecial stage from *Torrubiella* only in having part spores as broad as they are long. The type species, *B. stilbigera*, is parasitic on various species of *Trichia* and *Hemitrichia* in Ceylon. Unlike the two new species it has a stilboid conidial stage.

Petch (T.).—**The genus Cladosterigma Pat.**—*Trans. Brit. Mycol. Soc.*, viii, 4, pp. 212–215, 1923.

Examination of the type and other specimens from South America showed that *Microcera clavariella* Speg. is identical with *Cladosterigma fusisporum* Pat., which must therefore be known as

C. clavariella. It is parasitic on leaves of Myrtaceae. An allied but distinct genus has been found parasitic on insects and spiders in Ceylon, to which the name *Trichosterigma* n. g. (Stilbaceae) is given. It includes three species: *T. clavisporum*, found on a caterpillar attached to a living leaf; *T. arachnophilum* (the conidial stage of *Torrubiella flava* Petch), on a spider attached to a living leaf; and *T. attenuatum* on a Pentatomid on bark, in Ceylon. The genus differs from *Cladosterigma* in having simple, rigid, filiform sterigmata and continuous spores.

BARIBEAU (B.). **Flétrissure et pourriture de la tige du Tournesol dans la province de Québec.** [Stem wilt and rot of Sunflower in the province of Quebec.]—*Scient. Agric.*, iii, 11, pp. 397–400, 6 figs., 1923.

The author records the occurrence in 1921 and 1922 in several parts of Quebec of a stem rot of sunflower caused by a *Sclerotinia*. A similar disease has been reported from the State of Washington, United States, where Lawrence ascribes it to *S. perplexa*. The plants are affected when they are from 5 to 6 ft. high, as temperature and other factors do not favour infection of young seedlings. The first symptom is the appearance of a thick, whitish felting on the stem and a discoloration of the underlying tissues at soil level or a little higher up, sometimes as high as 3 feet. In wet weather an abundant mycelium is formed on the stems, which gradually penetrates the tissues and finally reaches the medulla; in the latter the hyphae spread rapidly and form numerous sclerotia. Under very wet conditions the attacked stems wilt, and frequently bend over at the diseased point. Experiments during the winters of 1922 and 1923 showed that the sclerotia resisted the action of severe frosts. In the soil they remain viable for at least two years. Apothecia have not been observed. Cross inoculations with pure cultures of the sunflower fungus gave positive results on carrots, onions, turnips, and broad beans. The author believes that it is *Sclerotinia libertiana*. Control measures should comprise the destruction of all infected plants and field rotation of at least two years with non-susceptible crops.

BUTLER (O.). **Experiments on the field control of Snapdragon rust together with a description of a method for the control of the disease in greenhouses.**—*New Hampshire Agric. Exper. Stat. Tech. Bull.*, 22, 14 pp., 2 diags., 1923.

The results of experiments carried out from 1918 to 1921 showed that the copper fungicides, cuprammonium sulphate, basic acetate of copper, and Burgundy mixture, afforded inadequate protection against snapdragon rust (*Puccinia antirrhini*), the death rate of the treated plants not being materially decreased.

Doran has shown [see this *Review*, ii, p. 281] that polysulphides are toxic as long as any sulphide is present. It is doubtful whether, in practice, any would be found six hours after a wash had been applied. After the sulphides have disappeared, the fungicidal properties of the mixture must be due to the sulphur, or to the sulphite, thiosulphate, or carbonate of the base used, acting singly or in combination. The toxicity of the decomposed calcium

sulphide and potassium or sodium sulphide will differ, therefore, according to the toxic properties of the resulting compounds. It was shown by experiments [which are described] that the sulphite, thiosulphate, and carbonate produced on the decomposition of calcium polysulphide are non-toxic to the spores of *P. antirrhinum.* at strengths likely to be used. A wash originally containing 0·8 per cent. potassium sulphide, however, is toxic even in the absence of sulphides and the toxicity of decomposed potassium polysulphide is stated to be due to the carbonate of the metal, in addition to sulphur.

In a comparative test of the efficacy of fine dusting sulphur and calcium polysulphide (10 applications between end of May and end of August) the latter gave less satisfactory control than the former. The reason for this is the less thorough distribution of the fungicide when applied as a spray than when in the form of a dust. It has been shown that if conditions have been favourable for the action of sulphur (as described in the next paragraph) spores collected from the sprayed leaves germinate more freely than those from dusted leaves. In the case of a liquid spray it is also much more difficult to reach both the upper and lower surfaces and thus ensure direct contact between the fungicide and the spores.

The decisive factor in the fungicidal action of sulphur is temperature. In the case of this rust the spores are killed by sulphur in 3½ hours at 21° C. but are not affected at a temperature of 12° C. In one of the tests snapdragon plants were divided into two lots, both of which were dusted with sulphur and then with rust spores. Lot 1 was placed in an incubator at a temperature of 15° and lot 2 in a sunny greenhouse, the shade temperature in which was 22°, for two hours. Both lots were then placed in a damp chamber at 15° for 24 hours and finally transferred to a greenhouse. The plants in lot 1 became thoroughly infected with the rust, while those in lot 2 showed no trace of the disease. This experiment shows clearly that the plants can be protected by sulphur if the prevailing temperature is sufficiently high. To ensure absolute protection a temperature of 22° should be maintained for 11 or 12 hours daily during the greater part of the week. The addition of soot to the sulphur for the purposes of heat absorption presented no advantages.

In the greenhouse the disease can be controlled by sulphuring with a bellows, at a temperature of 72° F., when the fungus begins to form spores, and maintaining this temperature for 11 or 12 hours daily until sporing ceases.

MAINS (E. B.). **Differences in the susceptibility of Clover to powdery mildew.**—*Proc. Indiana Acad. Science 1922*, pp. 307–313, 2 figs., 1923. [Received 1924].

Powdery mildew of clover (*Erysiphe polygoni*), the symptoms of which are described, suddenly assumed an epidemic character in many parts of the United States in 1922. The author has made some observations on the reaction of the different species of *Trifolium* to natural infection under field conditions. The mildew of red clover (*T. pratense*) is apparently specialized on that host,

crimson (*T. incarnatum*), alsike (*T. hybridum*), and white clover (*T. repens*) not being infected. American varieties of red clover were much more susceptible to the disease than European. In nearly all the varieties examined the presence of resistant individuals was observed, and it is believed that the disease could be largely controlled by selection and breeding.

McKee (R.). **Hungarian Vetch.**—*U.S. Dept. of Agric. Bull. 1174*, 11 pp., 4 figs., 1923.

Hungarian vetch (*Vicia pannonica*), which is stated to be particularly well adapted to cultivation in the Pacific Coast States and other parts of America, has not hitherto been attacked to any extent by leaf spot (*Mycosphaerella pinodes*) or false anthracnose (*Protocoronospora nigricans*), even when grown in close proximity to other species suffering from these diseases.

Brooks (C.) & Fisher (D. F.). **New methods of controlling Apple scald.**—*Amer. Fruit Grower*, xliii, 8, pp. 3, 12, 28, 1 fig., 1923.

Further experiments in the control of scald [see this *Review*, i, p. 386, ii, p. 455] on eastern apples packed in barrels and western varieties packed in boxes gave the following results in 1923. Grimes, 12th Jan.: unoiled wrapper 42 per cent. scald, oiled wrapper 0·1 per cent. York Imperial, 17th Feb.: unoiled 31 per cent., oiled 0·6 per cent. Rome Beauty, 3rd May: unoiled 30 per cent., oiled 0 per cent. Stayman Winesap, 19th March: unoiled 15 per cent., oiled 0 per cent.

The direct application to the fruits of oils and waxes, though greatly reducing the incidence of the disease, cannot be altogether recommended on account of its detrimental effect on the appearance of the fruit.

The wrappers used in the above experiments carried a minimum oil content of 15 per cent. of their dry weight. Wrappers carrying less than this amount are not so satisfactory and cannot be recommended for commercial use. In 1922 approximately 200,000 lb. of oiled paper were used in the Pacific Northwest. One of the largest shippers in the Wenatchee district packed forty carloads in oiled wraps and held them in cold storage for the May and June market. Fruit from the same orchards stored under the same conditions, except for the wraps, began to show scald in the early part of March, while that in the oiled wraps remained entirely free from the disease. On some of the sales the oiled wrap fruit brought a premium of $ 1.25 per box over similar fruit in common paper. The cost of the oiled wraps is 1 to 2½ cents per box greater than the ordinary wraps, but with claims and allowances for scald eliminated and the fruit in better condition to hold for a satisfactory market, the additional cost is considered a good investment.

Lind (G.). **Några förvaringsförsök med Äpplen 1922–1923.** [Some storage experiments with Apples 1922–1923.]—*Kungl. Landtbr.-Akad. Handl. och Tidskr.*, lxii, 5, pp. 429–434, 1923.

Two series of experiments in apple storage were instituted by the Stockholm Experiment Station in October 1922, in one of

which the fruit was kept in stone cellars with cement floors, while in the other it was placed in special cold storage chambers kept at about 0° C. and 75 per cent. relative humidity. Thirty varieties of apples were used in the tests, all the fruit being gathered between September 25th and October 7th. The fruit, which was of uniform size and in perfect condition, was laid on open shelves without wrappers or packing material. One week later packed Gravenstein and Åkerö apples, some wrapped in tissue paper and some unwrapped but surrounded by packing material, were added. During November the temperature in the cellars was 5°, in December 2·5°, in January 4°, in February 2°, and in March 3° C.

On January 26th, 1923, the loss from spoilage in the unpacked fruit amounted to 24 per cent. in the cellars and 21 per cent. in the cold stores. On March 20th when the test ended, the corresponding figures were 67 and 61·8 per cent. Certain varieties, such as Golden Pearmain and Golden Noble, kept better in the cellars than in the cold store. In most varieties the flavour was also better in the cellars. It is concluded that the cold storage did not repay its cost.

The packed fruit was not appreciably better in keeping quality than the unpacked, but it is recognized that certain varieties, such as Melon and Dronning Louise, are liable to shrivel when stored on open shelves. The place of origin of the fruit was found to have some influence on its keeping qualities. Scab [*Venturia inaequalis*] developed on susceptible varieties both in the cellar and cold store.

LAUBERT (R.). **Die Blattbräune, eine in diesem Sommer besonders verheerend aufgetretene Obstbaumkrankheit.** [Leaf browning, a particularly devastating disease of fruit trees this summer.]—*Deutsche landw. Presse*, l, 40, pp. 337–338, 2 figs., 1923.

Pears and quinces in the Berlin district and elsewhere were heavily attacked in the summer of 1923 by the fungus *Entomosporium maculatum*. The spots on quince leaves are larger and brighter in colour than on pear, and the writer doubts whether the forms of the fungus occurring on both hosts are fully identical in their morphological and biological characters; he thinks it may be advisable to distinguish them as f. *piri* and f. *cydoniae* respectively.

The fungus is transmissible from pear to apple leaves, but the closely related forms occurring on *Mespilus*, *Cotoneaster*, and *Crataegus* do not appear to be able to infect fruit trees.

Two or more applications of Bordeaux mixture (1·5 to 2 per cent.) or lime-sulphur are recommended for the control of the disease.

SANTE (E.). **Apfelmehltau auf Birnen.** [Apple mildew on Pears.]—*Deutsche Obst- und Gemüsebauzeit.*, lxix, 37–38, p. 292, 1923.

Outbreaks of the apple mildew fungus [*Podosphaera leucotricha*] occurred at Herford (Westphalia) after the hot weather in July 1923 on a number of espalier pear trees, the following varieties

being most heavily attacked: Duchess of Pitmaston, Tongre, Dr. Jules Guyot, Williams' Bon Chrétien, Marguerite Marillat, Triomphe de Vienne, and Alexander Lucas. Varieties with pubescent leaves (e.g., Countess of Paris) and with hard, shiny leaves were less susceptible to the disease.

Several summer treatments with one per cent. solbar are recommended for the control of the disease, together with appropriate cultural measures.

CAYLEY (DOROTHY M.). **Fungi associated with 'die back' in stone fruit trees. I.**—*Ann. of Appl. Biol.*, x, 2, pp. 253–275, 4 pl., 1923.

In this paper the author deals with certain fungi associated with die-back of peach, apricot, plum, nectarine, apple, and pear in England. On peach and plum a *Cytospora* agreeing fully with Wormald's description of *C. leucostoma* on cherry (*Journ. South-Eastern Agric. Coll.*, Wye, 21, 1912) was frequently found, but inoculations on plum have failed. It is thought that the fungus is a weak parasite.

By far the commonest fungus on stone fruit suffering from die-back was *Diaporthe perniciosa* [see this *Review*, i, p. 63]. It attacks trees of all ages, but is most injurious to young ones, which are generally killed. The progress of the disease in the host tissues is slow. Infection may have occurred years before any definite external symptoms are apparent, but once they appear the affected tissues die very rapidly, and the fungus completes its life-history as a saprophyte on the dead wood.

The mycelium kills the cortical tissues, phloem, cambium, and medullary rays, and penetrates the wood, causing considerable discoloration of the xylem tissues. The first external symptoms may be either rapid wilting and browning of the leaves during the growing season, or premature yellowing and fall of the leaves in autumn. In some cases the bark may take on a reddish tinge, or slightly sunken areas may extend longitudinally down the stem or branch, but more frequently no external symptoms appear until wilting sets in. The formation of callus at the edges of healthy tissues is very frequently responsible for more or less extended longitudinal splits in the bark, which lay bare the wood and thus increase the risk of secondary infection by other organisms. Later, transverse elongated excrescences form on the bark, which to the naked eye are very similar to the undeveloped lenticels on healthy bark, but much more numerous. The growth of stromata beneath or in between the external cork layers causes these excrescences, which ultimately burst and liberate spores in whitish, mucilaginous tendrils from pycnidia developed in the stromata. These pycnidia constitute the *Phomopsis* stage of the fungus, characterized by the production of 'a' and 'b' pycnospores. Later on perithecia of a Valsiform type develop, usually in the pycnidial stromata. These have numerous 8-spored asci. The ascospores are expelled either through the ostiolum at the tip, or through ruptures in any part of the long perithecial necks, which emerge from the transverse slits in company with the pycnospore tendrils. The pycnidial

stage is found on living or more or less moribund bark, while the perithecial stage occurs on the dead portions only.

Cultures from the 'a' spores of the *Phomopsis* stage grow and form pycnidia readily, but perithecia sparingly. While cultures of ascospores in mass have frequently resulted in pycnidia with 'a' and 'b' spores (the latter less regularly), mono-ascospore cultures have produced pycnidia very slowly and sparingly and without 'b' spores, while numerous perithecia were formed. Attempts to germinate the 'b' spores failed and no nucleus could be detected in them. The author is inclined to regard them as paraphyses rather than true spores.

Inoculation experiments with pure cultures of the fungus were successful, especially on peach; they caused the development of sunken lesions accompanied by gummosis but no wilting on one-year-old wood of plum, and produced rot in unripe apple and plum fruits.

Good cultural conditions and careful pruning are very important factors in the control of the disease. All cut surfaces should be treated with an antiseptic dressing, since most of the infections have been observed to occur in pruning or grafting scars. All diseased or dead wood must be cut out and the pruning tools disinfected in a solution of lysol. Prince of Wales plums and similar very susceptible varieties should be budded rather than grafted, and the buds should be taken from older trees, which have survived for many years. Buds from shoots showing traces of internal discoloration must be rejected. A bibliography of 62 titles is appended.

DODGE (B. O.). **Morphology and host relations of Pucciniastrum americanum.**—*Journ. Agric. Res.*, xxiv, 11, pp. 885–894, 5 pl., 1923.

This paper records the occurrence in America of *Pucciniastrum americanum* (Farl.) Arth. on numerous species and varieties of *Rubus*, including some cultivated varieties of the European red raspberry (*R. idaeus*), the American red raspberry (probably related to *R. strigosus*), and various hybrids between these and the black raspberry (*R. occidentalis*). An outbreak at Bell, Maryland, was sufficiently severe to cause defoliation and spotting of the canes. On the latter, cankers up to 2 or 3 inches long were formed.

The morphology and cytology of the fungus, the complete life-history of which is unknown, are described, and a bibliography is appended.

VOGLINO (P.). **L'imbrunimento delle Mele determinato dal fungillo 'Sphaeropsis malorum' Berk.** [The browning of apples caused by the fungus *Sphaeropsis malorum* Berk.]—*Nuovi Ann. Min. Agric.*, iii, 1, pp. 38–48, 5 figs., 1923.

While in America and France *Sphaeropsis malorum* [*Physalospora cydoniae*] is fairly common as the cause of wilting of the branches and of leaf spot of apples, it is only after a prolonged search that the author has been able to ascertain that this fungus may be responsible for the trouble locally termed 'sciatica' on

branches and leaves of apple trees in some districts in Piedmont, Italy. The fruit spot and dry rot caused by this fungus is, however, fairly common and is described in some detail by the author.

The 'sciatica' disease has of recent years caused important losses to the apple growers in the Selvaggio district. It is characterized by the appearance of elongated markings running along the large branches and young stems, affected trees becoming much enfeebled. The cortex within the longitudinal stripes dies and detaches itself gradually from the healthy bark, forming an ellipsoidal area which may extend for 30 cm. to 1 m. and more in length by 2 to 6 cm. wide. On this area the epidermis becomes detached from the cortex and wrinkled. On the affected branches, during the spring and summer, were also found leaves with numerous dried spots having a violet border. The examination of these leaf spots and stem lesions did not in every case reveal the characteristic mycelium of *Sphaeropsis malorum* as found in the fruit, and pycnidia of the fungus were rarely met with. On the other hand, perithecia of an ascomycete (referred to *Didymella hypochloea* Pass., though the spores were 15 by 5 instead of 15 by $2 \cdot 5\ \mu$ as given by Passerini) were very abundant in the epidermis. Hence the author is not prepared to attribute the stem and leaf disease definitely to the attack of *S. malorum*, though he has no doubt in regard to the fruit rot. Like other workers he has found *Diplodia*-like spores at times in the pycnidia, and the relationship of the fungus with the latter genus is discussed. In the author's pure cultures round, unicellular conidia were formed on short lateral stalks or longer, branched conidiophores. Pycnidia were ultimately developed in these cultures.

WINSTON (J. R.), BOWMAN (J. J.), & YOTHERS (W. W.). **Bordeaux-oil emulsion.**—*U.S. Dept. of Agric. Bull. 1178*, 22 pp., 3 graphs, 1923.

Bordeaux-oil emulsion, a mixture of 3–3–50 Bordeaux mixture and 1 per cent. of oil in the form of an emulsion, has come into prominence as a spray fluid for use in Florida citrus groves. Experiments in its use, extending from 1918 to 1922 are described [see this *Review*, ii, pp. 363, 364, 367]. The Bordeaux mixture is prepared in the regular way and the oil emulsion poured slowly into the diluted mixture while the agitator is running, agitation being continued during the application of the material.

Citrus scab and melanose (*Phomopsis citri*) have proved to be effectively controlled by this preparation, even when commercial Bordeaux preparations and home-made mixtures of poor physical properties have been used in making the emulsion. The combination spray is no more liable to burn delicate fruit and foliage than when the component parts are applied separately.

Bordeaux-oil emulsion settles less rapidly, spreads more uniformly, and adheres at least as well as plain Bordeaux mixture. It has the further advantage of mixing readily with both hard and soft water. Bordeaux mixture made with hydrated lime and oil emulsion has proved as effective against citrus scab and melanose as when prepared with quicklime.

Owing to the inhibiting action of the copper in the emulsion on entomogenous fungi, scale insects and white flies increase somewhat after its application, though usually not nearly so much as after plain Bordeaux. The rust mites usually become more abundant and reach their maximum number a week or two sooner on trees sprayed with Bordeaux-oil emulsion than on the untreated controls, so that the sulphur application for their control must be made somewhat earlier than would otherwise be necessary.

ZUCKSCHWERDT. **Verbesserte Kupferkalkbrühe.** [Improved Bordeaux mixture.]—*Deutsche Obst- und Gemüsebauzeit.*, lxix, 45, p. 348, 1923.

It is stated that the addition of a quantity of magnesium sulphate equal to that of the copper sulphate used in Bordeaux mixture greatly increases the efficacy of the latter in the control of vine mildew [*Plasmopara viticola*]. The adhesive properties of the mixture are said to be enhanced, and the precipitate remains in suspension much longer than in the ordinary mixture.

CLAUSEN. **Beizversuche mit 'Uspulun'.** [Steeping experiments with uspulun.]—*Deutsche Obst- und Gemüsebauzeit.*, lxix, 40, pp. 304–305, 2 figs., 1923.

Experiments on the stimulating effects of uspulun on seeds soaked in it showed that the yield of French beans was increased by 65 per cent., peas by 35 per cent., and beet by 60 kg. of roots per are [100 sq. m.] over the controls.

CHABROLIN (C.). **Les bouillies cupriques et les bouillies sulfocalciques dans la lutte contre les maladies des arbres fruitiers.** [Copper and lime-sulphur mixtures in the control of fruit tree diseases.]—*Journ. Soc. Nat. Hort. de France*, 4e sér., xxiv, pp. 251–282, 1923.

The estimated annual loss due to parasitic disease of fruit trees in the Rhône Valley is stated to be 20 million francs, or one-third of the total value of the harvest. The necessity of employing all the available means of control is therefore apparent. In this paper the author summarizes the results of experience up to date in the treatment of orchard diseases in this region. The methods of preparation of the various fungicidal solutions, the chemistry of these, their physical properties, and the appliances for spraying, both hand-operated and power-driven, as used in the United States and in France, are discussed. Spraying programmes against some of the chief fruit diseases are given in detail.

The general conclusions are that the most effective copper preparation is alkaline Bordeaux mixture (approximately equal weights of sulphate of copper and lime). Lime-sulphur solutions have been found to be inferior in their fungicidal action, possibly owing to their lesser adhesive power, although in certain cases their employment is advantageous, as for instance in the destruction of certain insects and of mosses and lichens. They are also very useful in mild fungous attacks, but their principal attraction undoubtedly lies in the very low cost as compared with the copper mixtures.

In discussing combined sprays, the author states that very alkaline Bordeaux mixtures, to which lead arsenate has been added, give the best results against scab and codling moth on pears and apples without risk of injury to the plant parts, while lime-sulphur preparations containing arsenate of lime also act satisfactorily in mild cases. It is, however, better to employ an arsenical preparation by itself for the application made to apples and pears at the end of the flowering period.

Dorogin (G. N.). Инструкция для производства испытания семян на присутствие грибных вредителей. [Instructions for the testing of seeds for contamination with fungous pests.]—Pamphlet edited by *Petrograd Plant. Prot. Stat.*, 23 pp., 1 pl., 1923.

This paper, compiled for the use of Russian Seed Control Stations, gives a short outline of the methods to be followed for the detection of contamination with fungous parasites in seed samples. Five different forms of contamination are considered, namely: (1) admixture with the seed of sclerotia or of small agglutinated spore masses; (2) mummification of the seed by fungal stromata (mycelium) or the presence of internal spores; (3) presence of mycelium only in definite parts or organs within the seed; (4) fructifications on the surface of the seed; and (5) spores.

The methods of examination recommended for each of these classes are described in detail: (1) the seed sample should be examined through a lens for detecting the presence of sclerotia or agglutinated spore masses, which should afterwards be determined in the usual way. The maximum permissible contamination, determined by weight, is 0·05 per cent., above which the seed should be cleansed either by hand or some adequate mechanical apparatus. (2) Deformed or discoloured seeds should be examined under the microscope for detecting the presence in them of mycelium (stromata), or crushed between the fingers and examined for spores in their interior. Seeds that are but little deformed by mummification should be placed in a damp chamber to induce the growth of the fungus, care being taken to avoid contamination with moulds or other organisms. The resulting fungi should then be cultured for identification. The permissible percentage of contamination is the same as in (1). Cleansing may be effected by washing in water, removing all the refuse rising to the surface, and subsequent treatment with disinfectants. In the case of mummified seeds such treatment is insufficient and should be completed by exposure to hot air, or the seed should be condemned as unfit for use. (3) Seeds infected in some of their parts only with mycelium should be soaked in water, sectioned, and examined under the microscope. The maximum permissible contamination is provisionally placed at 10 per cent. (4) Small seeds that may be infected by fungi producing fructifications on their surface should be examined with a strong lens and also under the microscope. (5) Seeds contaminated with spores on their surface should be shaken in water, which should then be centrifuged and the sediment examined under the microscope. Spores present in large quantities on the surface of the seeds may also be detected by

scraping the seed with a moistened scalpel and examining the scrapings under the microscope. The presence of a large number of mould spores on the surface of the seeds testifies to a poor quality of seed, or to bad packing. This should be noted in the reports; mould fungi which by their development lower the germination of the seed should be specially reported.

Brief descriptions are given of the principal organisms usually occurring on the seeds of the following plants in Russia: rye, oats, wheat, barley, millet, buckwheat, maize, flax, cabbage, peas, French beans, salad, clover, carrot, parsnip, celery, fennel, cucumber, sunflower, beet, birch, oak, and fir. A tabular list is given showing the organisms present most frequently on each of these seeds, and the class of contamination usually found in each case.

Revue bibliographique des travaux mycologiques publiés en 1921. [Bibliographical review of mycological works published in 1921.]—*Bull. Soc. Myc. de France*, xxxviii (Supplement), 133 pp., 1923.

This second fascicle of a series of annual bibliographical surveys of French and foreign mycological literature [see this *Review*, ii, p. 226] has been prepared on similar lines to those adopted in the first number.

LANG (F. J.) & GRUBAUER (F.). **Ueber Mucor- und Aspergillusmykose der Lunge.** [On *Mucor* and *Aspergillus* mycosis of the lung.]—*Virchows Arch.*, ccxlv, pp. 480–512, 17 figs., 1923.

Two cases, one of 'pneumomycosis mucorinea' and the other of 'bronchomycosis aspergillina', both fatal, are fully described, with special reference to their clinical aspects. The former was found to be caused by *Mucor corymbifer* and the latter by *Aspergillus fumigatus*.

MIEHE (H.). **Sind ultramikroskopische Organismen in der Natur verbreitet?** [Are ultramicroscopic organisms widely distributed in nature?]—*Biol. Zentralbl.*, xliii, 1, pp. 1–15, 1923.

After a brief introductory survey of the work of previous investigators, the author describes in detail certain experiments directed to determine whether any evidence could be obtained of the occurrence of ultramicroscopic organisms under natural conditions.

The filters used in his tests were so-called 'membrane filters' manufactured by the firm of de Haën (Seelze, Hanover) on the method described by Zsigismondy and Bachmann (*Zeitschr. anorgan. u. allg. Chem.*, ciii, p. 118). The liquids for filtration were obtained chiefly from the soil and consisted of extracts of humus from pine and beech woods and manured garden and compost soils, water being added when necessary to bring the samples to saturation point. The liquid was then expressed by a strong Buchner's press and either immediately filtered or previously evaporated *in vacuo* at a temperature of 30° to 33° C. to a half or a third of its original volume. Various other liquids exposed to organic contamination were also examined.

The filtrates were cultured on various media which were then examined microscopically, ultramicroscopically, and physiologically, but none showed any sign of the presence of micro-organisms below the limit of direct microscopic visibility.

In the soil filtrates extremely minute *Coccomyces* and very slender bacilli, somewhat resembling those of mouse septicaemia, were sometimes observed, while in one or two cases moulds and actinomycetes were present.

Milk filtrates were remarkable for their opalescence (in contrast to all the others which were perfectly clear) and contained exceedingly minute particles of casein (from 0·13 to 0·17 μ in diameter). Lactic acid bacteria were present in a stale milk filtrate.

A hay extract gave completely negative results, as did one from human faeces. However, in filtrates from *Azotobacter* cultures mixed with nutrient solution and garden soil, which was undergoing lactic fermentation, *Amylobacter*, *Azotobacter* of normal dimensions, and minute *Coccomyces* and bacilli were found.

These results appear to indicate that the presence of ultramicroscopic organisms, at any rate of the bacterial type, in nature is extremely restricted, if they occur at all.

The presence in the filtrates of visible organisms leads to the conclusion that the latter pass through ultravisible stages of development. Thus *Azotobacter chroococcum*, which at maturity measures at least 5 μ, must have passed the filter in a very much smaller stage, and the same is true of *Amylobacter*. The infectivity of filtrates in cases where the pathogen is known to be filterable may obviously be due to the occurrence of such stages in organisms which when fully developed in the host may be perfectly visible.

PAULSON (R.). **The fungus-root (Mycorrhiza).**—*Essex Naturalist*, xx, pp. 177–189, 3 pl., 1923.

A brief outline is given of the present state of knowledge of mycorrhiza, and the ectotropic form found in the birch, which is extremely abundant on trees growing in Epping Forest on light soil under a mulch of decaying leaves, is described in considerable detail.

The stigmas of the birch flower remain on the fruit until it falls in September, and even until the seed germinates. Before its fall hyphae can be seen twisted round the separate styles and passing in loose coils from one to the other. The examination of germinating seeds showed that the hypocotyl, which is studded with numerous minute, hooked processes, traverses the tangle of hyphae and carries some of them to the surface of the soil. They have not been traced into the soil in any quantity, but it is suggested that they may be of significance in connexion with mycorrhiza formation. The hyphae are 2 to 2·5 μ in diameter, frequently septate, with cells 15 to 18 μ in length, and producing spores while still attached to the styles. The fungus is stated to be probably *Sporotrichum pulviniforme*.

The formation of mycorrhiza appears to put no check whatever on the growth of the birch, which is very rapid during the first ten years of its life. The superficial roots bear mycorrhiza for the

greater part of the year, root hairs being absent. The structure of the mycorrhiza provides an effective channel for water passing from the fungous mantle to the central axis of the root. The thicker roots, from which the filiform, mycorrhiza-bearing rootlets arise, have well-developed secondary wood, through which water passes readily to the stem. The author advances arguments in support of the view that the tree profits from the association with the fungus.

It has been observed that different fungi can produce different mycorrhiza upon the same tree at the same time. On the rootlets of the birch are frequently found two distinct forms of fungous root, one brown and the other whitish-grey.

For more than twenty years past there have been continuous attacks of *Melanconis stilbostoma* on the birch trees in Epping Forest, resulting in the defoliation of the top branches. The epidemics of the disease, which were particularly severe in 1899–1901 and in 1922, have always been preceded by long periods of drought. In September 1922, it was found that the majority of the mycorrhiza and the roots to which they were attached had been killed by the drought. The water supply to the trees was thus diminished and it is assumed that the consequent reduction of vital energy rendered the leaves and young twigs more susceptible to fungous attacks.

COUNCILMAN (W. T.). **The root system of Epigaea repens and its relation to the fungi of the humus.**—*Proc. Nat. Acad. Sci., Washington,* ix, 8, pp. 279–285, 4 figs., 1923.

Epigaea repens, commonly known as mayflower or trailing arbutus, has a small, hard, irregular, often twisted and knobby underground stem, 2 to 4 cm. in length and rarely more than 1·5 cm. in diameter. Numerous capillary roots arise from the coarse, hard, larger roots which extend both laterally and downwards from the underground stem, filling the humus layers and upper soil for a diameter nearly equal to that of the entire plant. There is a complete absence of root hairs, but a fungus, which reaches its maximum development in the late summer and early autumn, is always found on the roots, especially on the capillaries.

The brown hyphae of this fungus form a plexus on the roots, though single hyphae often run for long distances without branching. Branches from the mycelium penetrate between the covering cells, and hyaline haustoria enter the cells both from the superficial mycelium and from the penetrating branches, forming in many cases a glomerular mass of fungous tissue filling the cavity of the cell. All the hyphae are usually about $0{\cdot}8\,\mu$ in diameter and the mycelium was not observed to be connected with hyphae present in the soil. The cell contents in contact with the fungus appear more granular and the cells larger than usual.

Plants examined from different localities in Maine, Massachusetts, and Maryland appear to show uniformly the same fungus in the same relation to the roots, and the examination of a dried specimen of *Epigaea* from Japan revealed identical conditions.

There is no reason to assume that this connexion is pathogenic. The more vigorous the plant, the more abundant is the fungus, and

there are some grounds for believing that the intracellular bodies represent a food supply for the plant, which it exhausts during blossoming and seeding. Plants taken from the same locality just before and during flowering showed a great difference in the fungus as compared with the summer and autumn. Few well-developed glomerular masses were found within the cells, in their stead being cells containing material resulting from the softening and disintegration of the hyphal mass. In some of these cells there was merely a small amount of an indefinite granular material together with some coloured granules, while in others fragments of swollen hyphae could be distinguished. In certain cases new hyphae were entering and dividing to form new glomerular masses.

The relation between plant and fungus is regarded as being one of perfect symbiosis. It is suggested that the nutritive material from the glomeruli is made use of during the flowering and seeding period, while the fungus may also take the place of the root hairs in absorbing water and salts from the soil. To the fungus both physical and nutritional advantages may result from the association.

McLuckie (J.). **Studies in symbiosis. III. Contributions to the morphology and physiology of the root-nodules of Podocarpus spinulosa and P. elata.**—*Proc. Linn. Soc. New South Wales*, xlviii, 2, pp. 82–93, 21 figs., 1923.

Investigations of the nodules of these two species of *Podocarpus* have established that they are caused by a bacterium which the author has not been able definitely to identify with *Pseudomonas radicicola*, though it has many points of similarity to this species.

The bacteria enter the young root though the root hairs and infect the lateral roots arising from the pericycle, preventing their normal growth and transforming them into nodules, clothed with root hairs. Penetration and passage from cell to cell are affected by zoogloeal threads, but free bacteria also occur in clusters in the cells. The active bacteria are small rods, but these become transformed into larger, oval bacteroids later on. Cells containing active bacteria are devoid of starch, whereas starch is found in non-infected cells of neighbouring tissues; it is thought, therefore, that the bacteria consume carbohydrate in the form of sugar supplied by the host.

Pure cultures of the organism showed numerous elliptical, coccus-like forms in addition to the usual rods. Grown in nitrogen-free media they were found to fix nitrogen vigorously, the amount fixed being from 6 to 7 mg. per 100 c.c. of the nutrient solution in 21 days at 25·5° C.

In the cortex of the main roots and of some of the nodules hyphae of a fungus believed to be of a mycorrhizal type were found, and similar hyphae form a close tangle on the surface of the young roots.

McLuckie (J.). **Studies in symbiosis. IV. The root-nodules of Casuarina cunninghamiana and their physiological significance.**—*Proc. Linn. Soc. New South Wales*, xlviii, 2, pp. 194–204, 16 figs., 1923.

The root nodules of *Casuarina* are much branched, modified

lateral roots, containing bacteria allied to *Pseudomonas radicicola* and closely resembling those found in *Podocarpus spinulosa* [see last abstract]. In each nodule there is a region near the apex, behind the meristem, containing zoogloeal infection threads of the bacteria. Below this there is a large zone of cortical tissue with many cells filled with bacteria, while towards the base are the older bacterial cells containing bacteroids. Pure cultures of the organism grown in nitrogen-free media were found to give an average of 5·4 mg. of nitrogen per 100 c.c. medium in 14 days at 26·5° C. A detailed account is given of the anatomy of the nodules, with notes on the cultural characters of the bacteria.

Hammarlund (C.). **Boletus elegans Schum. und Larix-Mykorrhiza.** [*Boletus elegans* Schum. and *Larix* mycorrhiza.]—*Bot. Notiser*, 4, pp. 305–326, 1 fig., 1923.

Preliminary tests in which larch seedlings, grown from sterilized seed in both sterilized (at 144° C.) and non-sterilized sandy garden humus in pots, were inoculated with *Boletus elegans* either by direct contact with the mycelium or by dusting with spores, resulted in the development of mycorrhiza in the unsterilized soil only. No hyphae were found on the roots in sterilized soil and only superficial ones, without the characters of mycorrhizal fungi, in the controls.

Further tests were then made with pure cultures of *B. elegans*, the best medium for growing which was found to be neutral soil sterilized with two per cent. formalin. Out of 68 larch seedlings in sterile soil inoculated by direct contact with mycelium from pure cultures, 52 developed mycorrhiza, while in another series inoculated with washed colonies all of 62 seedlings treated gave positive results, the uninoculated controls remaining free from the fungus. Fruit bodies did not develop even after 3 years, and this, in the author's opinion, renders it impossible to identify the mycorrhizal fungus definitely. He considers that Melin [see this *Review*, ii, p. 77] was not justified in assuming that an obligate connexion between the larch and *B. elegans* had been conclusively proved as a result of his experiments.

Further inoculations were made with the spores of the fungus. These proved excessively difficult to germinate in artificial conditions, only 3 out of more than 1,000 trials being successful. Of 20 seedlings inoculated with germinated spores, 18 gave positive results, while of 25 inoculated with ungerminated spores, 21 were successful. Twelve uninoculated controls remained free from mycorrhiza.

Ten vigorous plants with well-developed mycorrhiza were planted in sterile soil in pots, ten others, free from mycorrhiza, serving as controls. In two of the former, sporophores of *B. elegans* developed in the third year.

Negative results were obtained in all attempts to induce mycorrhiza by inoculation with *B. elegans* on ten other common trees tested, but trials with *Larix sibirica* gave mycorrhiza exactly similar to those on *L. europaea*.

To test whether other fungi could cause mycorrhiza to develop on the larch, a number of sterile larch seedlings, one year old, were

planted in various ecological associations in which *B. elegans* is not found. In two types of beech woods and two of pine woods mycorrhiza developed, but none formed in the seven other types tested. In the former cases either sterile mycelium of *B. elegans* must have occurred, or else other fungi can take its place, which is the more probable since the mycorrhiza differed considerably from that resulting from artificial infection with *B. elegans*.

Under the conditions of the laboratory tests the average height of 100 larch seedlings, six months old, was 58 mm. with mycorrhiza and only 52 mm. when mycorrhiza were not formed. In three years, ten plants with mycorrhiza averaged 27·6 cm. high, while five plants without averaged 22·1 cm. Only 2·7 per cent. of the mycorrhiza seedlings died before reaching the age of 8 months, as against 24·6 per cent. of those without mycorrhiza. Hence the larch evidently profits from its association with the fungus. That the latter also profits is indicated by the rapid growth of the hyphae in the presence of *Larix* roots, which was estimated to be three times as much as in their absence.

PEROTTI (R.). **La 'Batterioriza'.** [The bacteriorrhiza.]—*Riv. di Biol.*, v, 4, pp. 497–501, 1923.

The author proposes for the association of bacteria with the roots of phanerogams such as *Diplotaxis erucoides* and *Calendula officinalis* [see this *Review*, ii, p. 327] the name of 'bacteriorrhiza', analogous to the term and conception of 'mycorrhiza'.

The bacteria penetrate chiefly the tap roots but are also found in the lateral roots. Some of the strains succeed in adapting themselves to their new environment, and reproduction occurs in the cortex and external layers of the phloem, which may be described as the symbiotic region. They frequently occur in large numbers, and are readily isolated and cultivated. For the bacteria occurring in *Diplotaxis*, amides were found to be the best source of nitrogen and glucose of carbon. Growth is practically inhibited in solutions devoid of nitrogen. Starch is transformed and dissolved in great part. It has not been proved that the organisms fix nitrogen. Nevertheless the author is satisfied that the higher plant benefits from the association with bacteria, and suggests that the enzymes produced by the latter may have functions useful to the former.

PEROTTI (R.) & ZAFFUTO (G.) **Sui bacilli radicali della Calendula officinalis L.** [On the root bacilli of *Calendula officinalis L.*] —*Rendic. Accad. Lincei*, xxxii, 5th Ser., 2, pp. 94–98, 1923.

In this paper further details are given regarding the bacteria normally present in the roots of *Calendula officinalis* [see preceding abstract]. The method of isolation is described. The prevailing organism in Petri dish cultures on *Calendula* agar forms large, raised, roundish, finely punctate, and slightly sinuous colonies with an entire margin and transparent, mucilaginous consistency. It is a motile bacillus, varying in size on different media, between 1·3 by 0·7 μ and 3·5 by 0·8 μ; it stains well with gentian violet, or fuchsin, is Gram-positive, and liquefies gelatine. Milk is neither coagulated nor coloured. The cultural characters on various media

are briefly described, as well as the nutrient requirements in carbon and nitrogen of two of the strains isolated.

Dickson (B. T.). **Saltation in the organism causing 'black dot' disease of Potato in Canada.**—*Trans. Roy. Soc. Canada, 3rd Ser.*, xxvii, pp. 123–127, 1 pl., 4 diag., 1923.

In this paper the occurrence of saltation in cultures of the organism causing 'black dot' disease of the tubers and stem rot of potato in Canada [see this *Review*, ii, p. 26] is briefly described.

A subculture of the organism [previously referred to as *Vermicularia varians* but now merely stated to belong to the *Colletotrichum-Vermicularia-Volutella* group], from isolations made in August 1921, gave rise on 4th April 1922 to a thallus which in one half of the plate developed only sclerotia and in the other half only conidia. In September 1922 new field isolations were made, and on 31st January 1923 a single-spore culture from one of these developed four variant sectors, two of which were all conidia and two all sclerotia. The latter type of development is the normal in culture, and the variant producing only conidia is regarded as a saltant.

Subcultures were made from the variant sectors with the result that only sclerotia developed from the sclerotial sectors, except in one case which gave variant conidial sectors which continued true to type on subculturing from them. From the conidial sectors conidia, followed later by immature sclerotia (small mycelial knots), developed, except in one case where a sector bore sclerotia, and subcultures from this sector continued all to give sclerotial cultures.

All three types—the original, pure conidia, and conidia followed by immature sclerotia—were grown under uniform conditions and were still at the time of writing, when in the tenth generation, true to type.

Skinner (J. J.), Brown (B. E.), & Reid (F. R.). **The effect of borax on the growth and yield of crops.**—*U.S. Dept. of Agric. Bull.* 1126, 31 pp., 11 pl., 1923.

In 1920 experiments were conducted on co-operative lines in the States of Maine, New Jersey, Virginia, and Alabama, on various types of soil, to determine the effect of borax on different crop plants. Practically pure borax was mixed with a borax-free fertilizer in quantities ranging from 1 to 400 lbs. of borax to the acre, and applied to the soil in three different ways: (1) in the seed drill, the crop being planted after an interval of a week or ten days; (2) the same but planted immediately; (3) broadcasted and planted immediately. In all cases check plots received the same amount of fertilizer without admixture of borax. The plants tested included maize, Lima beans [*Phaseolus lunatus*], broad beans [*Vicia faba*], potato, and cotton.

The results showed that borax adversely affected the growth and yield of all the plants. Failure to germinate was common, and with Lima beans less than 50 per cent. germinated with 10 lb. borax per acre. The plants were weakened and bleached or

yellowed especially along the edges. The tips of the leaves were often killed, especially in maize. Stunting and distortion were caused in potato, cotton, beans, and maize, and the roots were usually much reduced. Potatoes can tolerate higher doses than plants like maize or beans, and may be even stimulated by doses up to 5 lb. per acre, whereas 2 or 3 lb. will injure maize, and 5 lb. caused a marked discoloration in maize and beans. The degree of injury, however, depended to a great extent on the amount and distribution of rainfall following the application, abundant rains apparently enabling the plants to withstand the action of higher doses by washing away a part of the borax from immediate contact with the roots. The way in which the borax was applied also exerted a considerable influence, the greatest injury resulting from drilling in the furrow, followed by immediate planting. While there was evidence of borax remaining in the soil for a period of some months even with considerable rainfall, the injury was practically confined to the drill rows with a high initial application of borax. In a cotton field no injury could be observed the second year after a failure of the crop caused by borax in the fertilizer used.

NOLTE (O.). **Beobachtungen zur sog. 'Bodensäurekrankheit'.** [Observations on the so-called 'soil acidity disease'.]—*Mitt. deutsch. Landw.-Gesellsch.*, xxxviii, 27, pp. 369–370, 1923.

From midsummer onwards, in 1923, a remarkable discoloration of cereals and stunting of root crops was very generally observed in Germany, and has been ascribed on what the writer considers to be quite inadequate grounds to an accumulation of acid in the soil [see this *Review*, ii, p. 499 and next abstract]. Not only have quantitative estimations frequently revealed little or no difference in the hydrogen-ion concentrations in the soils of healthy and diseased areas, but the latter included some with an alkaline reaction. The fact that the calcicolous Leguminosae were scarcely affected, and the improbability that an accumulation of acids could have persisted in face of the almost incessant rain in June are further reasons against accepting this explanation of the diseased condition, which was also most prevalent in cereals following root crops and therefore likely to be suffering from want of plant food. Attempts to remedy the trouble by applications of lime, calcium cyanamide, basic slag, or Rhenania phosphate gave satisfactory results, and still better effects followed the application of sodium nitrate, ammonium sulphate, and potassium chloride. The successful use of acid fertilizers is distinctly against the theory that acidity causes the disease.

The symptoms and conditions under which the disease occurred are considered to point to a deficiency of nitrogen as primarily responsible for it, and the application of liberal top dressings of nitrogenous fertilizers are recommended for its control.

CRÜGER. **Beobachtungen zur sogenannten 'Bodensäurekrankheit'.** [Observations on the so-called 'soil acidity disease'.]—*Mitt. deutsch. Landwirtsch.-Gesellsch.*, xxxviii, 43, pp. 553–555, 1923.

The writer considers that ordinary physiological disturbances of

cereals, due to abnormal meteorological conditions, are too frequently and hastily attributed to an injurious degree of soil acidity. The latter is characterized by the pale coloration of the foliage, the occurrence of whitish, clearly defined spots, the drooping of the leaves probably on account of a lack of turgidity, the frequent reddening of the base of the haulm and centre of the nodes, and, in advanced cases, the wilting of the leaves and shoots.

The damage caused by soil acidity is not, as frequently supposed, the effect of a direct action of the acid on the tissues of the roots, but is due rather to a resulting deficiency of such essential plant nutrients as potassium, phosphoric acid, lime, and sometimes nitrogen. The writer has observed the following incidence of injury from soil acidity: rye 136 cases; oats 74; barley 55; wheat 3; beet 3; clover, vetch, serradella, swedes, and fruit 1 each; lucerne 3.

The comparative freedom from the disease of the calcicolous Leguminosae is due more to the fact that they are not much cultivated on the light soils primarily affected by acidity, than to any inherent immunity. The seedlings of such plants are also frequently killed by this condition at a very early stage and therefore it is difficult to gauge the effect of the disease on the mature crop.

It is frequently asserted that the application of acid fertilizers is beneficial. In the writer's opinion this is only the case when the plants thus treated have passed the susceptible age. The application of alkaline fertilizers, on the other hand, can safely be recommended. Excellent results have been obtained by the application to diseased rye of 2 cwt. caustic lime and 1 cwt. calcium cyanamide per acre. [See also last abstract.]

HILTNER (E.). **Die Weisstüpfelung der Luzerne, eine Kalimangelerscheinung.** [The white speckling of Lucerne, a phenomenon due to lack of potassium.]—*Prakt. Blätter Bayr. Landesanst. f. Pflanzenbau und Pflanzenschutz,* i, 4, pp. 46–49, 1 fig., 1923.

In the course of fertilizer experiments on lucerne in May 1923 a white speckling of the leaves of the plants in the untreated control plots was observed. A similar phenomenon had been previously noticed (*Prakt. Blätter*, p. 116, 1908) on the Turkestan variety. In the present case the Franconian variety exhibited the most marked symptoms, plants of the Palatinate variety being less affected. Four of the treated plots, each of which was four square metres in area, received annual applications of 200 gm. potassium chloride and 400 gm. basic slag, while another four received nitrogen in addition to the potash and phosphorus. This was applied to the Franconian lucerne at the rate of 60 gm. sulphate of ammonia per plot, while to the Palatinate the same quantity of sodium nitrate was given.

At first the plants in the unfertilized plots showed no sign of injury, but later a great proportion of leaves showed the white speckling, while in some cases a slight yellow discoloration of the leaf edges spread towards the centre and produced a sickly appearance.

Previous investigations had shown that all the crops on un-

fertilized soil in the garden in question suffered severely from a deficiency of potassium, and it is concluded that the speckling of lucerne was due to the same cause. Microscopic examination showed that no fungous parasite was implicated. The protoplasm of the cells beneath the white spots was more or less coagulated and this resulted in the formation of cavities, some of which finally collapsed. There was shown to be a progressive loss of assimilatory power in affected leaves.

A similar phenomenon was observed in 1921 in oats grown in quartz sand and deprived of potassium. Numerous white spots, 0·5 to 1 mm. in diameter, were distributed over the entire leaves of seedlings 4 to 6 cm. in length.

In a test with red clover also, it was found that the leaves of plants receiving no potassium showed a typical, partly reddish, discoloration of the margins, accompanied by irregular mottling, the spots being about twice as large as those of lucerne.

Chittenden (F. H.). **Increasing the Potato crop by spraying.**—*U.S. Dept. of Agric. Farmers' Bull.* 1349, 23 pp., 23 figs., 1923.

The fungous diseases of the potato briefly described in this paper include late blight (*Phytophthora infestans*), sunscald, hopperburn, tipburn, and early blight (*Alternaria solani*). Of these the first named is most destructive, especially in northern New England, New York and the adjacent states, Iowa and Minnesota (in wet seasons), and parts of the Pacific Coast. The disease spreads most rapidly when the daily mean temperature is 72° to 74° F. with abundant moisture. The only preventive is the application of Bordeaux mixture [the 4–4–50 formula is recommended] every five to seven days from mid-July onwards. Potatoes should not be dug when the blight is still active, as the tubers become infected by contact with the tops while being harvested. Digging should, therefore, be postponed until a week or more after the tops are entirely dead. The sound tubers should be stored at a temperature of 36° F., and all infected ones discarded.

Spraying with Bordeaux also controls hopperburn and tipburn, and the methods of application of the mixture and of its combinations with arsenicals for the simultaneous control of insect pests are described.

The average increase in yield from spraying by these methods, in a series of experiments extending over nine years in New York State, was 36 bushels per acre, representing a net profit of $14·43 per acre, the average cost of the treatment being only $4·74 per acre. In other series of tests in New York and Vermont, over a period of ten years, the average gain from spraying was calculated at 60 bushels per acre, and during a twenty-year period in Vermont there was an average increase of 105 bushels, or 64 per cent., over the untreated controls.

Martin (W. H.). **Influence of soil moisture and acidity on Potato scab.**—*Soil Science*, xvi, 1, pp. 69–73, 1923.

Sanford has recently shown [see this *Review*, iii, p. 60] that soil reaction may not be the most important factor in the development

of common scab of potatoes (*Actinomyces scabies*). During the past three years the author has investigated at the New Jersey Experiment Station the relation of the scab organism to soil conditions.

A series of field tests, begun in 1920, to determine the residual effect of sulphur applications [see this *Review*, i, p. 82] both on the yield of the crop and the control of scab, was continued in 1921 and 1922. In 1921 the yield on both the treated and check plots was much lower, as a result of the drought, than in 1920 or 1922, while the incidence of scab was higher. In 1921 the mean P_H value of the control plots was 6·4, and 99·3 per cent. of the crop was unsaleable. In the adjacent sulphur plots, on the other hand, with a P_H value of 4·8, only 40·7 per cent. of the tubers were unmarketable. The same relation held good for 1920 and 1922. The results of further tests demonstrated conclusively that, with the same soil moisture content, the disease may be greatly reduced by increasing the acid reaction.

In the winter of 1921–22 a greenhouse experiment in sassafras loam soil was conducted to secure further information on the relation between soil moisture and scab, and the influence of the former on the oxidation of sulphur. The water-holding capacity of the twelve cultures ranged from 30 to 80 per cent., but those at 70 and 80 per cent. decayed before any data could be obtained. The cultures in one series received sulphur applications at the rate of 900 lb. per acre, while those in another were left untreated. Sections of Irish Cobbler tubers, previously disinfected in mercuric chloride, were used in the tests. The mean soil temperature in the low moisture cultures was 24·38° and that of the high moisture plots 23·95° C.

In the treated series there was a marked decrease in the number of scabby tubers as well as in the proportion of surface infected. In the cultures with a low moisture content 41 per cent. of the tuber surface was scabbed as compared with 2.6 per cent. of that in plots with a high moisture content. The corresponding figures for the untreated controls were 84·7 and 38·5 per cent. In every instance, regardless of soil moisture content, there was considerably less scab in the cultures with low P_H values than in those with high ones. In cultures with a moisture content of 30 per cent. water-holding capacity and a P_H value of 5·1, only 41 per cent. of the surface was scabbed in comparison with 84·7 per cent. in plots with the same moisture and a P_H value of 6·8. In the control cultures with highest moisture content all the tubers were infected, with 38·5 per cent. of the surface scabbed, while in the plots receiving sulphur, only 56·5 per cent. of the tubers were infected and only 2·6 of the surface scabbed. The mean P_H values of these cultures were 6·9 and 5·1 respectively.

Soil acidity appears from these results to be at least equally important with soil moisture in determining the incidence of scab.

MEIER (F. C.) & LINK (G. K. K.). **Potato brown rot.**—*U.S. Dept. of Agric. Circ.* 281, 6 pp., 2 figs., 1923.

Brown rot or southern bacterial wilt of the potato (*Bacterium solanacearum*), the symptoms of which are briefly described in

popular language, is stated to develop most rapidly at temperatures between 77° and 97° F., growth being virtually inhibited at 55° F. During transit or storage, therefore, the tubers should be kept at or below the latter temperature.

The organism appears to originate in virgin soils of the southern States, the virulence of the disease diminishing the longer the soils are cultivated and cropped. The Colorado potato beetle and other insects are responsible for much of its spread.

Kotila (J. E.). **Fall and winter care of Potatoes.**—*Quart. Bull. Michigan Agric. Exper. Stat.*, vi, 1, pp. 8–11, 4 figs., 1923.

Insufficient attention is generally paid to the various storage diseases of the potato, which annually result in the loss of thousands of bushels under Michigan conditions.

The chilling or 'field frost' injury to the tubers, which causes a brown or greyish-black discoloration of the flesh at the stem end just outside the vascular ring and about an eighth of an inch below the skin, is due to exposure to temperatures near the freezing point of water (32° F.) for several hours. This disturbance may be largely prevented by judicious harvesting, no more tubers being dug during the day than can be removed to the storage house the same evening.

Breakdown was particularly severe during the winter of 1922–23, when many growers, owing to the autumn slump in price, overloaded their storage rooms in keeping the potatoes till the spring. Losses of 25 and 30 per cent. of the stock were reported.

There are two types of breakdown, one being merely a superficial affection of areas of the skin and the other a deep internal discoloration of the flesh. In the former case the first symptoms are observed three or four months after the tubers have been placed in storage, and consist of slightly sunken, round or irregular spots varying from one-sixteenth to three-quarters of an inch in diameter, with bluish or gunmetal-coloured borders. The spots, known commercially as 'button rot', do not invade the tuber, and there is only a thin layer of dead cells beneath the skin.

More severe symptoms become apparent in the warm spring weather, when some of the tubers show the condition known as 'black heart'. This often occurs in refrigerator car shipments or in shipments where stoves cause overheating of the tubers. The injury is due to a deficiency of oxygen [see also this *Review*, iii, p. 145], the pitting manifested during the winter resulting from the death of the cells round the lenticels. Later in the season, when respiration is accelerated, the severity of the symptoms increases. Tubers affected with breakdown are very liable to attack by saprophytic bacteria which cause a foul-smelling decay.

The following control measures are recommended: provision of inlets for fresh and outlets for stale air in each cellar or storage house; of false floors and walls for the bins; and of air spaces between the bins. Potatoes should never be stored in piles more than 5 ft. deep without an arrangement for air to reach the centre of the pile.

[In a notice of this paper in the *Gardeners' Chronicle* (lxxiv, 1921, 1923) it is stated that the 'black heart' described appears

from the illustrations to be analogous to the condition known in Great Britain as 'sprain'.]

Roach (W. A.). **Studies in the varietal immunity of Potatoes to wart disease (Synchytrium endobioticum (Schilb.) Perc.). I. The influence of the foliage on the tuber as shown by grafting.**—*Ann. of Appl. Biol.*, x, 1, pp. 142–146, 1923.

Grafting experiments were undertaken to test the influence of the foliage on the immunity from or susceptibility to wart disease (*Synchytrium endobioticum*) shown by the tubers of different varieties of potato. The stems of vigorous plants 3 to 4 inches high were cut about an inch above soil level and replaced by similar stems taken from other plants. All the tubers produced on immune plants whether grafted with immune or susceptible tops gave immune progeny. All those of susceptible plants, however grafted, gave susceptible progeny. Hence, though the results are regarded as being of a preliminary nature only, it is concluded that the scion has no influence on the immunity from or susceptibility to this disease of tubers arising from the stock.

Potter (M. C.). **Wart disease of the Potato. Preliminary experiments.**—*Trans. Brit. Mycol. Soc.*, viii, 4, pp. 247–249, 1923.

Experiments to determine the relationship of soil alkalinity to wart disease of potatoes showed that *Synchytrium endobioticum* is sensitive to a high degree of alkalinity and fails to attack the potato when the P_H concentration of the soil is in the region of 10·5 or above. This high concentration, however, appears to affect the yield of the crop adversely.

Gaul (F.). **Kartoffelkrebs und Kartoffelsaatgutanerkennung.** [Wart disease of Potatoes and certification of seed Potatoes.]—*Deutsche landw. Presse*, l, 40, pp. 335–336, 1923.

Three years' experience in the inspection and certification of seed potatoes in the industrial districts of Thüringen have convinced the writer that wart disease [*Synchytrium endobioticum*] is frequently introduced in seed tubers ostensibly belonging to the immune varieties, Richter's Jubel or von Kameke's Hindenburg, but actually containing an admixture of a susceptible variety. It has been proved in several cases that the seedsmen, intentionally or otherwise, have simply named their stock 'Hindenburg' or 'Jubel' in order to comply with the regulations, without troubling to verify its identity. It is recommended that much more stringent measures than those at present in force in Germany should be adopted to safeguard potato growers from this disease.

Averna-Sacca (R.). **Contribuiçao para o estudo da biologia da anthracnose da Batatinha e principalmente de sua forma ascophora.** [Contribution to the study of the biology of anthracnose of Potato and especially of its ascigerous form.]—*Bol. de Agric. São Paulo*, Ser. xxiv, 7–8, pp. 272–282, 6 figs., 1923.

In this paper the author describes a very destructive potato

disease, which occurs both in the uplands and more virulently in the coastal regions of the State of São Paulo, Brazil. It is characterized by a very sudden wilting and a chlorosis of the green parts, progressing from the terminal portions towards the collar and roots and eventually killing the plant. Along the tips of affected leaves are extensive, irregularly spaced, concentrically zoned, grey patches, which, however, are absolutely sterile and are perhaps caused by solar radiation on the weakened plants. Diseased plants can be pulled out without effort, or break at the collar; the main root is whitish and dry, while the lateral roots are missing or scanty. The stolons are malformed and bear small tubers or none at all. The cortex of the underground parts is easily detached and exposes fructifications of a fungus on the central cylinder. Some of these belong to a species which the author identifies with *Colletotrichum solanicolum* O'Gara. This is found mainly on the still living portions of the roots and underground stems, rarely on dead parts. Another similar fungus sometimes occurs side by side with the last, from which it differs only in its conidia and setae. The conidia are hyaline, falcate, pointed, and 21 to 27 by 3 to 5 μ, as compared with the cylindrical or elliptical, hyaline, straight or slightly curved conidia of *C. solanicolum*, which measure 12 to 24·3 by 4·8 to 6 μ and have rounded ends, one of which may taper slightly. The setae of the former are longer and thicker than those of the latter, being up to 203 by 5·4 to 9 μ as against a maximum of 113 by 5·4 μ in *C. solanicolum*, both having from 2 to 5 septa. These differences clearly separate the two fungi, and the second form is regarded as a new species to which the name *C. littoralis* is given.

On the dead organs of the plant, associated with *C. solanicolum* or alone, an ascigerous fungus was found which is considered to be a new species of *Plowrightia* and named *P. solanicola*. This form appears as small prominent bodies, at first roundish, then depressed in the centre, and scattered or arranged in longitudinal series. When developed from the conidial acervuli, the latter increase in size and one or two globular, lenticular or slightly pear-shaped perithecia develop immersed in the swollen part. In some cases a perithecium which is unilocular at first becomes divided into two loculi later by the formation of a false septum. The asci are clavate and measure 56·7 to 70·2 by 13 to 14·5 μ. Each contains 8 distichous, elliptical, hyaline, continuous ascospores, 16·2 to 21·6 by 6·3 to 8·1 μ in diameter and with granular contents. Paraphyses are present. In the earlier stages the fungus may be mistaken for a *Glomerella* but the older fructifications cannot be assigned to this genus. The initial pale grey of the ascospores gradually darkens until they become almost sooty and at this stage a transverse septum divides the spore into two cells.

A pycnidial form, referred to the genus *Cytosporina*, was found on the living and dead portions of the plant, associated in the former case with *Colletotrichum solanicolum* and in the latter with the *Plowrightia*. It develops as scattered, spherical, black, shiny, thick-walled stromata, the cavities in which are lined with fine, hyaline, long, curved stalks, bearing at the apex small, bacillary or roundish, hyaline conidia, 2 to 4 μ in diameter.

Sterile sclerotia are often found on the main roots as small, spherical, superficial nodules, arranged in lines or clusters. These are pseudoparenchymatous in structure, with thick-walled, very dark cells.

In the upland form of the disease, elongated spots develop on the aerial stems. These may be 1 to 3 cm. in length, chestnut-brown at first and limited by a narrow zone of a deeper colour. Numerous black dots (? fructifications of the fungus) develop on these spots, scattered or arranged in concentric lines.

The cavities of the vessels of the affected fibro-vascular bundles are filled by the mycelium of the fungus together with a gummy deposit, and a similar gummy degeneration is found in the cortical and other tissues. Starch is absent from the infected regions or is partially or wholly gelatinized.

Suggestions for treatment are given, but it is recognized that treatment is impossible when once the underground parts are attacked. Disinfection of the tubers and the growing of resistant varieties are advocated. The disease is stated to be most severe in damp localities. The quarantining of affected areas is advocated.

CIFERRI (R.). **Su di un cancro del 'Ficus elastica'.** [On a canker on *Ficus elastica*.]—*Riv. Patol. Veg.*, xiii, 5–6, pp. 85–89, 2 figs., 1923.

A *Ficus elastica* tree growing in a garden near Turin, in Italy, showed an elongated, longitudinal cleft in the bark, which increased in depth year by year and was partly surrounded by a callous growth. On the latter appeared small white bodies, more or less isolated, somewhat depressed in the centre, generally roundish or subelliptical and 1 to 1·5 mm. in diameter. These were found to be the sporodochia of a *Volutella* with hyaline or rarely subhyaline, roundish conidia, 14·5 to 19 μ in diameter, and numerous, white, continuous, unbranched setae, 90 to 150 by 5 μ. The fungus is considered to be a new species and is named *V. petri*, a Latin diagnosis being given. It resembles somewhat *V. morearum* Roll., described in France on the cortex of *Ficus carica*, but differs in the spore characters. Inoculation experiments with pure cultures established the pathogenicity of the fungus, the disease produced by which appears not to have been previously described.

STOREY (H. H.). **Treatment of mosaic in Natal.**—*South African Sugar Journ.*, vii, 9, pp. 745–747, 1923.

It has now been definitely ascertained that mosaic disease of sugar-cane is present in Natal (and presumably also in Zululand) on imported Argentine canes, which were found to be infected to the extent of 100 per cent. The only means of eradicating the disease is stated to be the substitution for the infected canes of immune varieties such as some of the Coimbatore (India) seedlings, which are yielding from 60 to 70 per cent. more sugar per acre than any of the best canes previously grown.

In Uba cane, which is generally regarded as resistant to mosaic, a disease of a similar type has been observed, details of which, however, are not at present available. The variety is also unsuitable for cultivation on the flats and for irrigation.

The importation of new canes, which should be commenced without delay, should be safeguarded by the most rigorous legislation, all that are brought in being grown under strict quarantine to prevent the introduction of any disease.

Mosaic disease in Natal. Proposals for eradication.—*South African Sugar Journ.*, vii, 10, p. 808 c, 1923.

In a recent report by Mr. H. H. Storey, the Government Mycologist at Durban, it is stated that the Council of the South African Sugar Association has agreed to the principle of eradication of sugar-cane varieties susceptible to mosaic disease in Natal, and that legislation is proposed to prohibit the growing of any varieties other than those approved by the Minister of Agriculture and also of any cane whatever on land which, when the Act comes into force, is bearing cane of a variety not approved by the Minister of Agriculture.

B[ARBER] (C. A.). **On insect transmission of mosaic, especially in Java.**—*Intern. Sugar Journ.*., xxv, 295, pp. 346–351, 1923.

This is a detailed abstract of Miss Wilbrink's paper on the transmission of mosaic disease of sugar-cane, reference to which has already been made [see this *Review*, ii, p. 236].

GEERTS (J. M.). **Enkele gegevens over wortelrot bij EK 28.** [A few data concerning root rot in EK 28.]—*Arch. Sukerind. Nederl.-Indie*, 29, pp. 711–731, 1923.

The results of a careful examination of the statistics relating to root rot in the EK 28 variety of sugar-cane [see this *Review*, ii, p. 584] on fourteen different estates in various parts of Java, have shown that there is no foundation for the belief that there has been any general increase in the incidence of the disease or deterioration in the variety.

Generally speaking, the disease is worse under the biennial system of rotation practised in Java than under the triennial system. Figures are given supporting this statement for each individual estate inspected by the author, together with a table showing the average percentage of root rot from 1917 to 1923 for both systems. Except in 1917 and 1918, when the percentage of the disease was higher in triennial rotation than in biennial (1·35 and 2·05 per cent. as against 0·233 and 1·08 per cent.), the incidence of root rot was uniformly higher for the biennial system : for instance in 1923 the figures were 7·1 per cent. in the biennial and 1·76 per cent. in the triennial system.

In general, the disease is most severe in the crop from setts produced in the plains, and least so in that from setts imported from the hill nurseries. In 1923, however, the position was reversed, 15·2 per cent. of infection occurring in the crop from imported setts as against 6·9 per cent. in that from those grown locally. The disease is most prevalent in plants from two to three months old, and is frequently associated with the sharp alternations in soil moisture which occur in impermeable soils. There is little root rot on pure loam, red clay, sand, and alluvial soils.

ARNAUD (G.). **Étude sur les champignons parasites (Parodiellinacées: note complémentaire).** [Study of parasitic fungi (*Parodiellinaceae*: a complementary note).]—*Ann. des Épiphyties*, ix, 1, pp. 1–40, 10 pl., 38 figs., 1923.

In continuation of the author's researches on the Asterineae additional details regarding the Parodiellinaceae, and particularly the tribe of Parodiopsideae, are given. All the members of this tribe penetrate through the stomata, below which they often form characteristic swellings termed by the author 'stomopodia', from which hyphae spread through the intercellular spaces of the leaf tissues and form haustoria in the cells. Besides critical notes, each species studied is copiously illustrated, a list of the genera and species known is given, separate sections are devoted to their conidial forms and to the parasites of the Parodiellinaceae, and bibliographical details are appended.

PRITCHARD (F. J.) & PORTE (W. S.). **Watery-rot of Tomato fruits. A physiological form of Oospora lactis; effect on the host; penetration of the cell walls by enzymic action.**—*Journ. Agric. Res.*, xxiv, 11, pp. 895–905, 4 pl., 1923.

Tomatoes shipped from the Gulf States of the United States have been since 1921 very frequently found affected with a rot closely resembling that produced by *Bacillus carotovorus*, except in its slower development. The trouble is also prevalent in the neighbourhood of Washington, D.C. The rot is characterized by the extremely watery appearance and condition of the affected tissues, by the absence of any other discoloration, and by the occasional oozing of water from the surface, features which distinguish it from other fungous soft rots. The affected areas generally develop in the form of sectors from the stem scar toward the blossom end, covered in very humid weather with a white, velvety to granular, fungous growth. No pronounced odour is associated with the rot. The causal organism has been found to be a physiological form of *Oospora lactis* [see this *Review*, ii, p. 91] to which the name *O. lactis parasitica* is given. It is a wound parasite and usually enters the fruit through the stem scar. The unbroken cuticle is not penetrated. Although ripe fruits are generally preferred, the fungus is capable of rotting green fruits quite readily. Invasion of the host cells is soon followed by a gradual consumption of their protoplasmic contents, facilitated by a proteolytic enzyme secreted by the growing hyphae. The middle lamella is slowly dissolved and the cells lose their coherence. A similar action was produced by the ground dried organism and its extract and also by the filtrate and the alcoholic precipitate from the filtrate of young cultures, but this action rapidly deteriorated with increased age of the cultures.

Penetration of the cell walls is believed to result from the action of a cellulase secreted by the tips of the hyphae, and not merely from mechanical pressure.

The optimum temperature for the growth of this fungus is 30°, the minimum about 2°, and the maximum between 37·5° and 38·5° C.

Experiments on the effect of dipping the fruit in antiseptic solutions showed that immersion for 30 minutes in 1 to 40 chloride of lime solution or 1 to 240 formalin considerably reduced the percentage of infection.

Modification of fruit and vegetable quarantine. Amendment No. 1 to regulations supplemental to notice of quarantine No. 56.—*U.S. Dept. of Agric. Fed. Hort. Board*, 23rd October 1923.

On and after 1st November 1923, hothouse-grown grapes, sour oranges from Spain, avocados from the West Indies, and other specialities which can be accepted by the Department of Agriculture as free from the risk of carrying fruit flies (*Trypetidae*) and other injurious insects, may be imported into the United States under such conditions and through such ports as shall be designated in the permits.

The Destructive Insect and Pest Act (Canada) and regulations thereunder. *Acts, Orders and Regulations* No. 8, 18 pp., 1923.

The following Regulations have been framed by the Destructive Insect and Pest Act Board (Canada) [see this *Review*, i, p. 408] to take effect on and after 1st September 1923.

Regulation No. 6, intended to prevent further introductions of *Cronartium ribicola*, prohibits the importation into Canada from all foreign countries of white pine (*Pinus strobus*); western white pine (*P. monticola*); sugar pine (*P. lambertiana*); stone or Cembrian pine (*P. cembra*); and all other five-leaved species of *Pinus*.

No. 7, framed as a safeguard against chestnut blight [*Endothia parasitica*], prohibits the importation of chestnut (*Castanea dentata*) and chinquapin (*C. pumila*), including all hybrids and horticultural varieties thereof, from Asia and the United States.

No. 8 aims at restricting the incidence of white pine blister rust [*Cronartium ribicola*] by prohibiting the importation, from all foreign countries, of all species and varieties of currants and gooseberries (not including the fruits of the latter).

No. 9 is designed to prevent the dissemination of crown rust of oats [*Puccinia coronata*] and black stem rust of wheat [*P. graminis*] by prohibiting the importation of European buckthorn (*Rhamnus cathartica*) [see this *Review*, ii, p. 528] and common barberry (*Berberis vulgaris*), as well as all susceptible species of *Berberis* and *Odostemon* (*Mahonia*), a list of which is given.

No. 13 prohibits the importation of all species and varieties of the genera *Pseudotsuga*, *Tsuga*, and *Larix* from countries other than the United States in order to exclude from Canada a serious European disease of conifers [*Phomopsis pseudotsugae*: see this *Review*, i, p. 48].

No. 14, designed to prevent the introduction into British Columbia of peach yellows [see this *Review*, i, p. 298], prohibits the importation into that province of all peach nursery stock from the states of Wisconsin, Illinois, Kentucky, Tennessee, Mississippi, and the area east thereof.

No. 15 prohibits the importation into British Columbia of plants

or cuttings of hazel, cob, or filberts (*Corylus*) from Montana, Wyoming, Colorado, New Mexico, and all States east thereof, in order to prevent the introduction of eastern filbert blight [*Cryptosporella anomala*].

Tanganyika Territory plant pest and disease (import) regulations, 1923. Dar-es-Salaam, 27th July, 1923.

Under the 'Plant Pest and Disease (Import) Regulations' 1923, the importation into Tanganyika Territory of all living plants and of coffee seeds (except beans intended for human consumption) and cotton seeds is prohibited except under permit from the Director of Agriculture, who may prescribe conditions. All such imports may be effected only by parcel post, unless by special permission of the Director of Agriculture. The importation of living or dead coffee plants, the plants of any stone fruit, or portion thereof, apple and pear stocks, seed potatoes, citrus plants or fruit (unless grown in Zanzibar or Pemba), and sugar-cane cuttings, is absolutely prohibited unless facilities exist for their examination and treatment by an inspector under the Ordinance. Inspectors are authorized to order the detention, disinfection, treatment, or destruction of any infested plants, soil, packing material, or covers, without compensation. The importation of used agricultural implements, soil, or of any insect, is prohibited except by permission of the Director of Agriculture.

Décret relatif à l'organisation des recherches agronomiques. [Decree providing for the organization of agricultural research.]—*Ann. Science Agron.*, xl, 5, pp. 286–291, 1923. [Received 1924.]

In reply to representations by the Minister of Agriculture on the organization of the Institute of Agricultural Research established by the decree of 30th April 1921, the President of the French Republic issued, on 5th November 1923, a decree which may be summarized as follows.

Provision is made for scientific researches for the increase of agricultural production by the Institute of Agricultural Research by means of central and branch stations, the former to be subdivided as follows: (1) agronomy and biology of soils; (2) agricultural physics and meteorology; (3) microbiology; (4) agricultural entomology and parasitology; (5) phytopathology and vegetable parasitology (the functions of this section will comprise the investigation of means for the protection of cultivated plants against diseases due to fungi or bacteria or any other cause except insects, and the destruction of weeds and phanerogamic parasites); (6) zootechnology; (7) animal nutrition; (8) epizootics.

The branch stations will specialize in practical and experimental work in the agricultural methods appropriate to the particular districts in which they are situated.

IMPERIAL BUREAU OF MYCOLOGY

REVIEW

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GÄUMANN (E.). **Beiträge zu einer Monographie der Gattung Peronospora Corda.** [Contributions towards a monograph of the genus *Peronospora* Corda.]—*Beiträge zur Kryptogamenflora der Schweiz,* v, 4, 360 pp., 166 figs., 1923.

This comprehensive survey of the genus *Peronospora* comprises a discussion on the species-concept within the genus; a key to the identification of the Swiss species, with their hosts; a detailed account of the author's investigations of the species of *Peronospora* occurring in Switzerland; a list of 63 species to be excluded from the genus; and a bibliography of over 360 titles.

NOWOTNY (R.). **Zur neueren Entwicklung der Holzimprägnierung mit wasserlöslichen Stoffen.** [The recent development of wood impregnation with water-soluble substances.]—*Oesterr. Chem. Zeit.,* xxvi, 17, pp. 124–125, 1923.

The history of the use of fluorides for the preservation of timber is briefly traced from Malenkovič's investigations at the commencement of the present century. The same investigator, in 1909, obtained by the admixture of dinitrophenolaniline with fluoride a soluble preparation which was named 'basilite' ('bellite'). and which has proved very efficacious for the preservation of telegraph poles in Austria and pit props in Germany.

Dinitrophenol possesses slightly acid properties liable to damage the iron vessels used for impregnation; the addition of aniline oil is therefore recommended and is preferable to alkalis on account of its non-inflammability. Subsequent investigations showed that mixtures of dinitrophenolsodium with sodium fluoride (the latter in excess) are perfectly safe to use. Other preparations based on Malenkovič's discovery are triolith (Grubenholzimprägnierungs-Gesellschaft), consisting of sodium fluoride, dinitrophenol, and a little bichromate to protect the iron against the attacks of the

nitro compound; schwammschutz (Rütgers, Berlin) and fluoran (Aussig Chemische Fabrik), which are also composed principally of sodium fluoride and dinitrophenol; and malenite, consisting of sodium fluoride, dinitrophenolsodium, and a slight admixture of a soluble antimony salt, e. g. tartar emetic, or of soluble double salts of the antimony fluoride SbF_3 with alkali salts.

The distinguishing characteristic of malenite is the admixture of a water-soluble antimony compound. This, when brought into contact with the constituents of the wood, e. g. tannin, induces voluminous precipitation, while the formation of Sb_2O_3 also takes place within the wood. These processes contribute to the adhesion of the preservative to the wood fibres and thereby reduce the risk of washing out. The antimony double salt itself has active fungicidal properties (Netzsch, Inaug. Diss., Munich, p. 62, 1909), while Malenkovič has shown that the addition of 0·39 per cent. malenite containing 7 per cent. dinitrophenol (or 0·36 with 8 per cent. dinitrophenol) was sufficient to prevent the growth of fungi in glucose-gelatine media.

Similar tests of basilite of the original constitution (11·11 per cent. dinitrophenolaniline, corresponding to 7·37 per cent. dinitrophenol, +88·89 per cent. sodium fluoride) showed the necessary quantity for inhibiting fungous growth to be 0·33 ± 0·02 per cent. Thus the antiseptic power of the two preparations is about the same when calculated on the dinitrophenol content, and it is a matter of indifference whether the aniline or the sodium salt of the nitro-body be used; the decisive factor is the content of the latter.

In cases where it is desirable to procure a particularly strong disinfectant against wood-destroying fungi, malenite can be used with a higher dinitrophenol content, e. g. 20 per cent., or orthodinitrocresolsodium may be substituted for the phenol derivative.

The fear that the soluble fluoride would rapidly be washed out of the wood has proved to be groundless in practice. Sodium fluoride is not nearly so easily washed away as copper sulphate or zinc chloride. According to Malenkovič ('Preservation of timber by fluorine salts and other compounds'. *Amer. Wood Pres. Assoc.*, 1923), in comparative tests 76·1 per cent. of copper sulphate, 50·4 per cent. of zinc chloride, and only 27·8 per cent. of sodium fluoride were washed out of the wood.

The writer states that wood preservation by means of water-soluble substances has already been proved to have decided advantages, and anticipates further progress along these lines.

Nowotny (R.). **Ueber praktische Erfahrungen bei der Holzkonservierung mit Fluoriden.** [Practical experiments in the preservation of wood with fluorides.]—*Zeitschr. für angew. Chemie*, xxxvi, 60, pp. 439–440, 1923.

An examination of Austrian data regarding the treatment of telegraph poles and other structural timber with sodium and zinc fluorides showed that of 14,500 poles treated with zinc fluoride, 5·9 per cent. suffered from decay after 5 years and 24·2 per cent. after 12 years, while of 13,134 treated with sodium fluoride, 3·2 per cent. were decayed after 5 and 11·3 per cent. after 10 years.

These results are superior to those obtained with copper sulphate,

zinc chloride, or corrosive sublimate. In Germany also good preservation has been effected by the treatment of pit props in mines with a mixture of zinc sulphate, sodium fluoride, and sodium bisulphate, the treated props being free from fungous decay after 4 to 5 years, while those untreated decayed within a year.

Sodium fluoride is the effective principle in basilite, triolith, fluoxith, fluoran, and malenite. Experiments in its use in the United States [*U.S. Dept. of Agric. Bull.* 227, 1915] showed that it was twice as effective against *Fomes annosus* and five times as effective against *F. pinicola* as zinc chloride. Sodium fluoride is stated to be preferred to tar oils in the mines in the United States on account of its non-inflammability and freedom from noxious vapours. It has the further advantage of not corroding the metal of the steeping tanks as some other preservatives do. Its use has, however, been limited hitherto by its high cost, and cheaper sources of supply should be sought for, e. g. the hydrogen fluoride from phosphorite, of which there are large deposits in the United States.

Boyce (J. S.). **Decays and discolorations in airplane woods.**— *U.S. Dept. of Agric. Bull.* 1128, 52 pp., 7 col. pl., 9 figs., 1923.

After a brief description of the principal species of timber used in the construction of aeroplanes, the author gives a summary account of defects in timber arising from accidents during the growth or felling of the trees, insect or mechanical injury, improper drying, seasoning of the timber, &c. Injury to wood arising from the activity of various fungi is dealt with at greater length, and a comprehensive popular description is given of the symptoms of incipient decay caused by the most commonly occurring wood-rotting fungi in the timbers dealt with, namely: *Fomes laricis, F. igniarius, F. roseus, F. geotropus, F. fraxinophilus, Trametes pini, Polyporus sulfureus, P. schweinitzii, P. dryophilus, P. amarus, P. adustus, Echinodontium tinctorium, Stereum subpileatum, S. hirsutum, Merulius lacrymans, Lenzites saepiaria*, and *Polystictus versicolor*.

A special section is devoted to wood-staining fungi, the activity of which is not considered to impair the strength of the wood, while disfiguring it for purely ornamental purposes. Hints are also given for controlling the spread of the fungi during the storage and transport of the timber. A bibliography of 75 titles is appended.

Hiley (W. E.). **Fungus and bacterial diseases of Poplars.**— *Forestry Comm. Bull.* 5, pp. 47–50, 1 pl., 1923.

There are three types of canker on various species of poplar, caused by *Micrococcus populi, Dothichiza populea*, and *Cytospora chrysosperma* respectively.

Micrococcus populi, hitherto observed only on *Populus regenerata* in France, Belgium, and Italy, produces elongated, oblong, yellow spots on the bark, which subsequently ruptures, the canker spreading both longitudinally and transversely and becoming depressed in the centre.

Dothichiza populea [see this *Review*, ii, p. 96, and iii, p. 71]

attacks chiefly *Populus angulata* in France, *P. deltoidea* in Italy, and *P. nigra* var. *italica* and *P. serotina* in America. Fructifications of this fungus have also been found on dead branches associated with cankers on *P. nigra italica* in England. It is not a virulent parasite and cannot kill vigorous trees. Nursery seedlings, young trees, and old trees growing on excessively dry or water-logged soil are most liable to attack.

Cytospora chrysosperma is said not to have been recorded as parasitic on poplars in Great Britain, but occurs in the United States. The first symptom of the disease is the appearance of minute dead patches on the bark, which become slightly sunken and enlarge until the branch is girdled. Cankers are only formed where the spread of the fungus is restricted to a few inches each year and the tree makes constant efforts to heal the wound. Fructifications of the fungus may be found at any season on dead twigs still covered with bark, or on the cortex over a canker. They appear as fine, black points piercing the bark, from which yellow threads of mucilage, about $\frac{1}{8}$ inch in length, emerge in wet weather. The black points are connected by a tube with nearly circular, chambered pycnidia. Unsuitable conditions and pollarding render the trees more susceptible to the disease.

Brief notes are given on *Armillaria mellea*, which is apt to attack poplars growing in overcrowded stands; *Polyporus sulfureus*, causing a red rot and cracking of the wood; *Fomes igniarius* and *Pleurotus ostreatus*, both producing white rots; *Exoascus aureus*, the cause of bladder-shaped deformations on the leaves of *P. nigra* and other species; and heteroecious species of *Melampsora*, the aecidial stages of which occur on the larch and Scots pine.

FOËX (E.). **Une maladie du Peuplier.** [A disease of the Poplar.]—*Rev. hort.*, xcv, 21, pp. 476–477, 1923.

Poplar twigs submitted for inspection from Le Touquet-Paris-Plage (Pas-de-Calais) were found to be attacked by *Cenangium populneum* (*Dothichiza populea*) [see this *Review*, iii, p. 71, and last abstract]. Prunet, who thoroughly investigated the disease in the neighbourhood of Toulouse, found that the entry of the fungus is generally effected through wounds. The affected area, greyish-green in colour, sometimes extends for 20 to 30 cm. and bears the pycnidia of the fungus, which are about the size of a pin's head. In course of time the lesion extends in depth also, sometimes penetrating as far as the medullary region.

Bachala, in his treatise on poplar cultivation in the south-west of France, regards the ultimate destruction of affected trees as almost inevitable. They may, however, be saved in the very early stages, before the formation of the pycnidia, by the excision of the affected area and of the part extending round it for about 1 cm., the wound being dressed with tar. He also recommends the planting of nurseries on moderately fertile, well cultivated, and copiously manured soils, avoiding those that are contaminated; selection of healthy cuttings, which should be sprayed before planting with Bordeaux mixture (3 per cent. copper sulphate); appropriate cultural measures, including the destruction of infected material;

and a lapse of 5 to 6 years between each planting of poplars on the same soil in the nursery. Planting out should be done early (during December) and the young plants should be carefully inspected, all dead twigs being removed and the wounds treated with coal tar. The plantations should be inspected, with a view to removing diseased material, during the first few years.

JONES (S. G.). **Life-history of Rhytisma acerinum (preliminary account).**—*Ann. of Botany*, xxxvii, 148, pp. 731–732, 1923.

The needle-shaped, unicellular ascospores of *Rhytisma acerinum* germinate readily in weak prune decoction, first becoming bi- or (rarely) triseptate. In the host the extremely fine mycelium develops rapidly within the upper epidermal cells, which are completely filled by the hyphae. Infected areas first appear as yellow patches with black centres, in which are developed stromata and subsequently pycnidia containing simple conidiophores from which are abstricted enormous numbers of minute, uninucleate conidia, the function of which is unknown. The apothecia usually arise *de novo* at the margin of the stroma, but may develop from the pycnidia. They open by the rupture of the outer wall along cracks which are filled by a yellowish exudate. The ascospores are periodically and forcibly ejected in large numbers.

PETRI (L.). **Sul modo di diffondersi del mal dell' inchiostro del Castagno e sui mezzi più efficaci per combatterlo.** [On the mode of spread of the ink disease of the Chestnut and on the most efficacious means of control.]—*Nuovi Ann. Min. Agric.*, iii, 1, pp. 3–19, 4 figs., 1923.

According to the data available in 1923 the number of Italian communes in which the ink disease of chestnuts [see this *Review*, iii, pp. 5–8] has been recorded is 137, including one in Sicily. The general trend of the spread of the disease is from east to west, and north to south. Sporadic outbreaks have also been recorded in the provinces of Campobasso and of Palermo, while the flourishing chestnut plantations in the Avellinese are still uninfected.

In the author's previous publications [*Rendic. Accad. Lincei*, xxvi, 5th ser., 2d. sem., fasc. 11, 1917, and *Ann. R. Ist. Super. Forest. Naz.*, iii, 1918, and vii, 1922] the cause of the disease was shown to be a Phycomycete closely allied to *Phytophthora*, to which the name *Blepharospora cambivora* n. g., n. sp. was given. The essential points in the biology of this fungus are summarized in the present paper. The organism can live saprophytically in the leaf mould on the surface of the soil. Sporangia are formed in this situation and the zoospores, which are liberated after a fall of rain, disseminate the fungus over short distances. Oospores have hitherto been found in nature only on the young seedlings arising from fallen fruit. Unlike the zoospores, which are short-lived and easily killed by drying or weak antiseptics, the oospores are very resistant, and are the probable agents of long distance dissemination, which is thus not readily secured. In the tissues of more mature trees the mycelium is sterile. Infection occurs by means of mycelial strands or spores on the surface of the soil and has not been traced to contact of diseased and healthy roots. Man is

responsible for much of the spread, especially owing to the custom of forming heaps of leaf mould from the chestnut groves in order to prepare compost for fruit trees. The fungus flourishes in such heaps. The transport of living parts of trees from infected groves is also a source of dissemination. Spread through the air is not believed to occur to any extent. Infection occurs at the base of the trunk or through the roots at or near the surface of the soil.

Protective sprayings of the base of the trunk and of a small soil area surrounding it with Bordeaux mixture (5 per cent.), to which 1·5 per cent. glue is added to increase its adhesive qualities, have given good results. As soon as trees show the first symptoms of the disease they must be felled, and removed with as much of their underground portion as possible.

To fill the gaps caused by the ink disease, the immune varieties of the Japanese *Castanea crenata*, which have been successfully introduced in France, are advocated, but so far the difficulties of a successful conveyance of seed from Japan, and the failure of attempts to graft European chestnuts on *crenata* stocks, have interfered with their utilization. Seed derived from the few Japanese trees already existing in Italy is, however, available. Grafts from these are also being grown on Italian chestnuts, and it is hoped in a few years' time to have about 400 seed-bearing *crenata* plants available. In the meantime it is suggested that seed and grafts of the Japanese chestnut should be imported from France.

Suggestions are made for additions to the existing laws directed to check the spread of the disease, and a summary of the best methods of dealing with an outbreak is given.

LAUBERT (R.). **Ueber besonders heftiges Auftreten einiger Frühjahrskrankheiten von Ziergehölzen im Jahre 1923.** [The particularly severe occurrence of some spring diseases of ornamental trees in the year 1923.]—*Gartenwelt*, xxvii, 28, pp. 222–224, 1 fig., 1923.

The three diseases briefly described in this article were unusually prevalent in the spring of 1923, and the author discusses the influence of meteorological conditions on fungous diseases in general. The *Fusicladium* disease of aspens [*Populus tremula*] produces on the leaves of the young May shoots pronounced, large, spherical spots of a dark greyish-brown colour, often covered with a delicate olive-green down on the upper side and surrounded by a black rim. The affected portions of the leaves, which are usually distorted, dry up, while the pedicels and tips of the shoots are also attacked. The disease is caused by *Fusicladium radiosum* (Lib.) Lind. (*Venturia tremulae* Aderh.).

The leaf disease of the bird cherry (*Prunus padus*) is characterized by large, discoloured, withered areas at the base, margin, or midrib, which are frequently covered by a delicate grey down. The disease is arrested in May, when the heavily infected leaves fall. The fungus also penetrates the ovary through the style and completes its development in the infected fruit. The causal organism is *Monilia linhartiana* (*Sclerotinia padi*).

Prunus triloba was heavily infected by a wilt disease caused by

a species of *Botrytis* which resulted in the desiccation, immediately after flowering, of the new shoots and the terminal shoots of the previous year's branches.

KENDRICK (J. B.). **Phytophthora rot of Tomato, Eggplant, and Pepper.**—*Proc. Indiana Acad. Science, 1922,* pp. 299–306, 2 figs., 1923. [Received 1924.]

In August 1921 a *Phytophthora* rot, apparently identical with the 'buckeye' rot known to be caused by *P. terrestris,* occurred in an epidemic form on tomatoes at Lafayette, destroying about 40 per cent. of the fruit and rapidly spreading to adjacent plots of eggplant [*Solanum melongenum*] and sweet pepper [*Capsicum annuum*]. The same fungus (which is stated to be probably *P. terrestris*) was repeatedly isolated from diseased fruits, and successful inoculations were secured on eggplant and pepper with isolations from tomato. Inoculations on watermelon and potato gave negative results.

The symptoms of the disease on tomato (only the fruit of which is affected under Indiana conditions) closely resemble those of buckeye rot as described by Sherbakoff (*Phytopath.*, vii, p. 119, 1917). On the fruit of the eggplant the fungus produces a dark brown spot with a conspicuous pale border, and causes a discoloration of the tissues, especially in the vascular bundles, and premature shedding of the infected fruit. The symptoms on pepper are less pronounced than on the other hosts. A small, dark green, water soaked spot appears on the green fruits, rapidly enlarging and causing premature dropping.

Possibly the organism may be transmitted by means of the soil on the roots of young plants. In 1921 tomatoes grown in the experimental field at Lafayette (which had been used for the same crop in 1920) developed the disease, which may have persisted in the soil.

The maximum development of the fungus was attained at about 30° C. in a humid atmosphere. An abundance of soil moisture is believed to be a very important factor in the causation of the disease.

HIGGINS (B. B.). **The diseases of Pepper.**—*Georgia Agric. Exper. Stat. Bull.* 141, pp. 48–75, 11 figs., 1923. [Received 1924.]

The following principal diseases of the pepper plant (*Capsicum annuum*), which is extensively grown in Georgia for canning purposes, are described and figured.

Damping-off caused by *Rhizoctonia* [*solani*] may be controlled by keeping the surface of the soil loose and dry. This is best effected by planting 4 to 6 inches apart, soaking the soil thoroughly, and strewing a heavy layer of air-slaked lime between the rows.

Sclerotium blight (*S. rolfsii*) caused losses in 1922 amounting to between 50 and 75 per cent. of the crop in certain districts, and observations indicate that its severity increases annually where susceptible crops are planted for several years in succession. The results of recent culture experiments showed that the fungus

thrives in an acid medium, and it is therefore believed that the application of lime (1 ton stone or 1·5 tons hydrated per acre) to the soil will prove beneficial. *S. bataticola* occasionally attacks pepper, but has not caused extensive damage under Georgia conditions.

Mosaic disease greatly reduces the yield of the crop, and in seasons favourable to its development may be most destructive. The results of controlled experiments conducted at the Georgia Experiment Station have proved that aphids are capable of transmitting infection from diseased to healthy pepper plants. It has also been shown elsewhere that aphids feeding on mosaic tomato plants can convey the disease to pepper. The virus is believed to overwinter on one or more of the Solanaceous weeds, which should be carefully eradicated from the pepper fields. The application of nicotine dust for the control of aphids is also recommended.

Cercospora leaf spot (*C. capsici*), causing defoliation and sometimes decay of the fruit, is not serious except under abnormally humid conditions. The method of overwintering of the fungus is still uncertain; infection sometimes appears to take place in the seed-bed.

Bacterial spot [*Bacterium vesicatorium*; see this *Review*, ii, p. 196, and iii, p. 119], which causes severe damage to all the aerial parts of the plant and contaminates the seed at the cannery, may be controlled by seed disinfection by means of any of the several disinfectants in common use, or by exposure for ten minutes to water heated to 50° C.

Blossom-end rot, believed to be due to tissue break-down induced by an irregular supply of moisture, frequently causes heavy losses (up to 90 per cent.) in the early crop. The disease develops most abundantly during very dry weather following heavy rains. The best preventive measures so far discovered are the application of organic manure and the turning under of cover crops.

Anthracnose (apparently produced, under conditions in Georgia, by several different species of *Gloeosporium* and *Colletotrichum*) is readily controllable by seed treatment with corrosive sublimate or hot water. *Macrosporium* and *Alternaria* rots will also yield to seed treatment. On the other hand, seed should never be saved from pepper fruits affected by *Phoma destructiva*.

It was shown by experiments that the corrosive sublimate treatment of fresh seed stimulated germination, while the same process six months later retarded it. Formalin without subsequent liming produced serious injury in fresh seed. Copper sulphate followed by lime improved germination,but root development was affected where lime was withheld.

MILBRATH (D. G.). **Downy mildew on Lettuce in California.**—*Journ. Agric. Res.*, xxiii, 12, pp. 989–993, 3 pl., 1923.

Heavy losses both in the field and in transport are reported to be caused in California by downy mildew (*Bremia lactucae*). The disease is favoured by local climatic conditions, and has attained its present severity owing to the fact that the 'New York' variety mainly cultivated is highly susceptible. The symptoms in the field are briefly described as well as the morphology of the fungus, which is stated to continue to develop in the refrigeration chambers,

though much of the damage after packing is probably due to secondary organisms. An additional form of reproduction by means of zoospores, hitherto unrecorded in *B. lactucae,* was found. They develop most readily in the dark at a temperature of about 10° C., especially from conidia produced during the cool months, December to March. The zoospores are hyaline, globular, ciliated, motile for several hours, and about 4·2 μ in diameter.

The disease occurs throughout the year, but is most severe in the winter months. Varietal tests showed that several varieties are comparatively resistant to attack, and it is believed that the best method for the control of the disease will be the selection of improved strains from these varieties.

GREGORY (C. T.). **Onion smut in Indiana.**—*Proc. Indiana Acad. Science, 1922,* pp. 318–320, 1923. [Received 1924.]

In Munster County, Indiana, where the onion-growing industry is of considerable importance, the losses from smut [*Urocystis cepulae*] frequently amount to 50 per cent. of the crop or more.

It has been conclusively proved that the formalin 'drip' treatment will control smut effectively where the onions are sown at the rate of 5 to 7 lb. per acre. In Lake County, however, where they are sown at the rate of 60 lb. per acre, full control has never been secured by this method, probably because the formalin only moistens an area about ¾ inch wide, whereas the row of seedlings under these conditions covers 1¼ inches. Another important factor in the control of the disease is the amount of rain at and immediately after planting [see this *Review*, iii, p. 184]. Growers also believe that spring ploughing loosens the soil so much that the formalin penetrates too deeply for proper disinfection.

In one experiment where one pint of 40 per cent. formaldehyde in 16 galls. water was used at the rate of 200 galls. per acre, the treated onions had about 5 per cent. of smut as compared with 50 per cent. in the untreated beds, and an increased yield of 100 bushels per acre was obtained. Somewhat better control was secured in 1922 by using 140 and 160 galls. of the solution at a strength of one pint in 10, 12, and 14 galls. of water. During the summer, however, the abnormal heat and drought had a particularly adverse effect on the treated plants, which originally promised extremely well. The explanation of the trouble appeared to be the depletion of soil moisture by the drought to such an extent that the heavy, treated stands were unable to develop; while in the greatly reduced, untreated stands there was less competition and consequently more chance of growth for the survivors. The thick stands, however, are of course an additional argument in favour of treatment, since in normal years they would produce an excellent yield.

BREMER (H.). **Untersuchungen über Biologie und Bekämpfung des Erregers der Kohlhernie, Plasmodiophora brassicae Woronin.** [Investigations on the biology and control of the causal organism of club-root of Cabbage, *Plasmodiophora brassicae* Woronin.]—*Landw. Jahrb.*, lix, 2, pp. 227–243, 1923.

Experiments were undertaken in 1923 at the Proskau Fruit-

Growing and Horticultural Institute to test the accuracy of the statement that the spores of *Plasmodiophora brassicae* can be absolutely destroyed by the application to the soil of suitable disinfectants.

In the tests the viability of the spores was determined by plasmolysing them in a concentrated salt solution and subsequent deplasmolysis by returning them to water.

In a preliminary experiment to test the effect on the spores of solutions of uspulun in concentrations of 0·01 to 0·25 per cent. it was found that at the latter strength the spores were only destroyed after five days, while at the former some were still viable after a fortnight.

Sections of infected cabbage roots were placed in four types of soil, namely, reclaimed marsh, heath, compost, and sand, and treated with 0·5 gm. uspulun per kg. of soil for 5 days in July during a very dry period. The greatest reduction in living spores occurred in the heath and sandy soils, the hydrogen-ion concentration of which was estimated at P_H 5·4 and P_H 7·5 respectively. This corresponds with the common observation that drought adversely affects *Plasmodiophora* spores. Even in the untreated soils (except the compost) the number of living spores decreased in the course of the test, the high soil temperature (average 25·8° C.) probably aiding in this. The experiment was repeated a little later when there was an average daily rainfall of 3 mm. and a mean soil temperatureof 19·7° C. A calcareous clay soil was also included in the test. There was no appreciable reduction in the number of living spores, except in the reclaimed marsh and heath soils, in which case it was due in a much higher degree to the escape of the amoebae than to the death of the spores. It should be noted that both these soils had an acid reaction (P_H 4·3 and 5·4 respectively), and Chupp has stated (*Cornell Agric. Exper. Stat. Bull.* 387, 1917) that the escape of the amoebae from the spores is favoured by acid media.

Another test was made with larger quantities of uspulun (up to 3 gm. per kg. of soil) and lasting 22 days. The application of 1 gm. per kg. resulted in the destruction of about half the spores, but no further improvement was effected by the use of higher concentrations.

A test lasting 30 days was conducted in the greenhouse with sections of infected cabbage roots placed in flower-pots (containing compost) at a depth of 9 cm., 4·5 cm., and close to the surface. The soil was treated with 0 to 3 per cent. uspulun. Only close to the surface was there any reduction in the number of living spores even at the higher concentrations; probably dryness and heat were also involved in this effect.

It is suggested that the good effects reported to follow the use of uspulun are due to its action on the more sensitive amoebae rather than on the spores, and that it does not guard against reinfection of the soil.

Similar experiments were undertaken with formalin containing 3 and 10 per cent. formol, at the rate of 5 l. per sq. m., the stronger solution effecting a satisfactory reduction on the dry soils (more especially on the reclaimed marsh soil) in 12 days. Used at the

ordinary strengths, however, it cannot be regarded as a satisfactory remedy.

Carbolineum (0 to 10 c.c. florium per kg. of soil) effected an appreciable reduction in the living spores after 27 days only at the highest concentration, which would be much too expensive to use.

The results of experiments in the application of caustic lime (30 gm. per kg.) to the soil showed that the excellent effects produced by this treatment are due rather to the retardation of germination by reduction of the acidity of the soil than to any toxic action on the spores.

PETRI (L.). **L'arricciamento della Vite è una malattia prodotta da protozoi?** [Is leaf roll of the Vine a disease produced by protozoa?]—*Rendic. Accad. Lincei*, xxxii, 5th ser., 8, pp. 395–397, 1 fig., 1923.

During cytological studies of the root extremities of vines affected with leaf roll ('roncet') [probably the same as court-noué: see this *Review*, iii, p. 75], the author was led in 1918 to suspect the presence of a plasmodium, but the morphological characters of the organism were not sufficiently defined to give certainty, nor was it found possible to isolate it. More recently a cytological examination of the leaves of diseased vines has revealed in the phloem of the principal leaf veins elongated, undulating bodies measuring 18 to 25 by 0·8 to 1·2 μ and sometimes with polar flagella, which took the stain (iron-alum haematoxylin) vigorously. In many cells these bodies were found in the neighbourhood of, or in contact with, the nucleus, which showed evident signs of chromatolysis. This is held to account for the diminished growth of the veins in relation to the parenchymatous tissues. These observations agree closely with those of Nelson on mosaic and related diseases [see this *Review*, ii, pp. 227, 513–516], but the author points out that bodies similar to those found by Nelson in the sieve-tubes and adjoining cells are often nothing more than fusiform cell nuclei joined to the surrounding stratum of cytoplasm by very thin protoplasmic filaments having the appearance of flagella. Moreover, during a certain developmental stage of the sieve-tubes, their contents shrink to elongated bodies, which lie in the longitudinal axis of the cell, and which sometimes have a sinuous outline. Hence the nature of these supposed protozoa should be taken with reserve until they have actually been isolated.

YOSSIFOVITCH (M.). **Contribution à l'étude de l'Oïdium de la Vigne et de son traitement.** [Contribution to the study of *Oidium* of the Vine and its treatment.]—Thèse Doct. Univ. Toulouse, 1923. [Abs. in *Bull. Soc. Bot. France*, lxx, 5–6, p. 574, 1923.]

The structure of the mycelium, conidia, and perithecia of the vine *Oidium* [*Uncinula necator*] was investigated. It was shown that water induced the spontaneous rupture of the perithecia, as well as the opening of the asci; it is equally indispensable to the emergence, germination, and probably to the dissemination of the ascospores. It is only by means of rain that the perithecia are detached and removed from the organs on which they are borne. The only

methods of overwintering which can be regarded as established are by means of the perithecia and by the mycelium in the buds.

The minimum temperature for spore germination was found to be 4·5° to 6·5° C., the optimum 25° to 28°, and the maximum near 35°. Although humidity is very favourable to development, the latter can take place in a comparatively dry atmosphere, rain not being essential.

The changes undergone by the host as a result of the attacks of *Oidium* were investigated, with special reference to the effect of the parasite on transpiration. It is concluded that the fungus produces a drying-out effect which often results in the wilting of the affected organs.

The second part of the thesis deals with methods for the control of the disease. Sulphur is effective by reason of its oxidation products, its action being diminished by humidity. It should be pure, extremely fine, and adhesive. Alkaline polysulphides exert a more intense action than sulphur, especially in cold weather. Quicklime is effective only in a dry atmosphere, and permanganate appears to be of little use. Excellent results are stated to have been obtained with sulphur vapours, using the Vulcan apparatus manufactured by the firm of Schloesing (Marseilles).

Moreau (L.) & Vinet (E.). **Contribution à l'étude de la maladie de l'esca (apoplexie de la Vigne) et de son traitement.** [Contribution to the study of the esca disease (apoplexy of the Vine) and of its treatment.]—*Comptes Rendus Acad. d'Agriculture de France*, ix, 38, pp. 951–953, 1923.

In pursuance of their investigations on the etiology and control of the 'esca' disease or apoplexy of the vine [*Fomes igniarius*: see this *Review*, ii, p. 437], a further series of experiments was made during 1923.

Between 3rd February and 30th March heavily infected vines 24 years old were sprayed with the commercial arsenical products pyrafolliol and pyralion. In one plot some of the vines were sprayed between 26th and 30th March, while others were left untreated.

Dry weather prevailed from June to October and conditions were therefore unfavourable to the development of esca. By the end of the season (26th October) there were only 11 dead and 16 infected vines per mille among the untreated controls as compared with 65 dead and 71 infected in 1922. In the treated portions of the vineyard there were no fatal cases and only 2·4 per mille of infection.

It was further shown that the efficacy of the treatment is always experienced in the year in which it is given; that a single application in the previous year confers only relative protection; and that vines treated two years in succession may safely be left untreated the following year.

No difference was observed between plots treated eight or forty days after pruning, which was carried out from 3rd January to 20th March. Hence it appears that the treatment for esca may safely be given throughout the dormant period, irrespective of the time of pruning.

Report of the Chief of the Bureau of Plant Industry.—*U.S. Dept. of Agric. Bur. of Plant Ind., Washington, D.C.*, 34 pp., 1923. [Received 1924.]

The following references of phytopathological interest, other than those already mentioned in this *Review*, are included in the Report.

Strains of wheat immune from, or highly resistant to, bunt [*Tilletia tritici*] have been obtained from hybrids and selections o commercial varieties in Oregon, Washington, and California. The Ridit, Hussar, Martin, White Odessa, Sherman, and several strains of Turkey, are being extensively tested.

In connexion with studies in Illinois on flag smut of wheat [*Urocystis tritici*: see this *Review*, iii, p. 129] the Shepherd and other promising resistant varieties are being increased as rapidly as possible, and it is believed that there is every prospect of thorough control by growing these varieties. During 1923 the disease was recorded for the first time in Kansas and in nine fresh counties in Illinois and Missouri. Similar experiments in the control by selection of wheat rosette [see this *Review*, iii, p. 84], the cause of which is still obscure, also gave encouraging results.

Comparative investigations of healthy wheat and maize seedlings and those infected with scab [*Gibberella saubinetii*] showed that at comparatively low soil temperatures the wheat develops vigorously, with thick cell walls, which soon become lignified or suberized and highly resistant to the fungus. At higher temperatures the wheat seedlings develop feebly, with thin and largely pectic cell walls which are readily penetrable by *G. saubinetii*. Exactly the reverse was found to be the case with maize. These results are in accordance with field observations on the seedling blights of these crops [see this *Review*, ii, p. 536]. Special studies on the head blight type of wheat scab showed that a high degree of humidity during flowering is most conducive to infection. This observation agrees with field experiences in 1919 and 1920, when the greatest losses from scab occurred in areas with a heavy rainfall at the critical period.

True Australian take-all of wheat (*Ophiobolus graminis*) [*O. cariceti*] occurred in Oregon, Washington, California, Arkansas, Kansas, New York, and, to a very slight extent, in Tennessee and North Carolina.

In addition to bacterial wilt (*Aplanobacter stewartii*) and bacterial root and stalk rot (*Bacterium dissolvens*), an apparently new bacterial disease of maize is being investigated. The principal fungi recorded as aggressive parasites in maize root rot were *Diplodia zeae*, *Cephalosporium acremonium*, and *Gibberella saubinetii*. The first-named organism appears to cause most damage when high soil temperature and extreme soil humidity are combined during the seedling stage. *Fusarium moniliforme*, the ascigerous stage of which is stated to have been developed in culture, is frequently associated with the above-mentioned organisms, but does not seem to be actively parasitic on healthy plants.

The Laredo variety of soy-bean and the Victor cowpea have been found resistant to wilt [? *Fusarium* sp. and *F. tracheiphilum*].

The woolly podded vetch continues to prove its value in the southern States on account of its vigour and resistance to *Protocoronospora nigricans*.

Field tests conducted on 'tobacco-sick' soils in the Connecticut Valley showed that timothy sod, red clover, and maize exercised a most unfavourable effect on the succeeding tobacco crops, which throve much better after onions, tobacco, and on land kept fallow during the previous season.

The deterioration of raspberries and loganberries in shipments to Chicago and elsewhere was investigated at Mountain View, California. Careful handling and precooling of the fruit were found to prevent the bulk of such losses. Similar studies on nuts showed that English walnuts were still in good condition after 3 years' storage at 32° F., while pecans and filberts were fairly sound after 2 to $2\frac{1}{2}$ years at the same temperature. Almonds showed some degree of decay at the end of this period. At 40° F. the nuts scarcely last more than 1 or $1\frac{1}{4}$ years in common warehouse storage.

Further studies on mosaic disease of potatoes have revealed three distinct types, namely, mild, rugose, and leaf rolling mosaic. Fertilizers with a high nitrogen and potash content mask the mottling symptoms to some extent but do not reduce the incidence of the disease. Controlled experiments showed that the percentage of healthy plants increases with the distance from diseased plants, while the proportion of infection fluctuates seasonally and regionally with aphid infestation.

Extended observations on the correlation between leaf roll and net necrosis confirmed previous conclusions that net necrosis tubers produce leaf roll plants, but that not all the latter arise from tubers with net necrosis. Leaf roll is apparently much less prevalent in seed-growing sections in the east than mosaic or spindling tuber [see below, p. 296].

Investigations on the root rot of canning peas showed four organisms to be chiefly involved, namely, *Aphanomyces* sp., *Pythium de Baryanum*, *Fusarium martii* var. *pisi*, and *Rhizoctonia solani*. The infection persists in the soil, increasing from year to year, and is at present only controllable by long crop rotation.

Further investigations on white pine blister rust [*Cronartium ribicola*] showed that western white pine [*Pinus monticola*] is more susceptible than eastern white pine [*Pinus strobus*]. All the 16 north-western species of *Ribes* naturally or artificially infected in greenhouse tests were found to be susceptible to rust, particularly *Ribes bracteosum* and *R. petiolare*. The elimination of the highly susceptible black currant (*R. nigrum*) greatly delays the establishment of the disease in new territory.. Unprotected areas in the north-eastern States have been found to be generally infected, and the volume of aecidial production is stated to be rapidly increasing. At the end of the 1921 season, 16 per cent. of the trees in these districts were found to be infected, while in areas where the disease has long been established infection amounted to 60 to 100 per cent. Further particulars of the blister rust campaign [see this *Review*, ii, p. 107] are given.

The waste due to blue stain of lumber material [chiefly caused

by *Ceratostomella* spp.: see this *Review*, ii, p. 103] is estimated at $10,000,000 per annum, and investigations of possible control measures are in progress in the southern yellow pine [*Pinus palustris*] region. The decay of building timbers has been investigated in various southern States, and the preservation of groundwood pulp is also receiving attention. It is believed that one of the new preservatives under trial will reduce the cost of pulp preservation from $2.50 to 50 cents per ton.

JØRSTAD (I.). **Beretning om plantesykdommer i land og havebruket 1920–22. II. Frukttrær og baervekster.** [Report on plant diseases in agriculture and horticulture 1920–22. II. Fruit trees and small fruits.]—*Christiania, Grøndahl & Søns Boktrykkeri*, 73 pp., 22 figs., 1923.

Apple rust (*Gymnosporangium tremelloides*), which produces conspicuous rust-coloured spots on the leaves and also occurs in a mild form on the fruits, is very prevalent in all apple-growing districts of Norway. The most susceptible varieties appear to be Signe Tillisch and Gravenstein, Rosenstrips being fairly resistant. Treatment with lime-sulphur immediately before flowering is recommended where the complete eradication of all junipers from the vicinity of the orchards is impracticable.

Along the coast from Christiania to Sogn a biological form of the same fungus occurs on *Pyrus aria*, and *P. prunifolia* was once found infected. The closely allied species, *G. juniperi*, is prevalent on mountain ash [*P. aucuparia*] and various other wild and cultivated species of *Pyrus*, whence it is transmissible to apples, but only forms the pycnidial stage on the latter host.

Apple mildew (*Podosphaera leucotricha*) is particularly severe on the Signe Tillisch, Gravenstein, Sävstaholm, and Blenheim Pippin varieties in the west of the country. As in Germany [see this *Review*, ii, p. 220], the disease appears to be greatly on the increase in Norway. The occurrence of the perithecial stage is by no means infrequent, but the mycelium overwintering in the buds is responsible for most of the infection. The best means of control appears to be the application of lime-sulphur, colloidal sulphur, sulphur dust, or ammonium polysulphides with soap, immediately before and after flowering, while a third treatment three weeks later may also be advisable. The same treatment will generally suffice to control scab (*Venturia inaequalis*), which is stated to be the most important fungous disease of apples in Norway, and, like mildew, seems to be increasing in severity.

Monilia (*Sclerotinia*) *fructigena* and *M. cinerea* f. *mali* are of very general occurrence on apples, the former being especially severe in the west on White Astrakhan, Charlamowsky, and Langballe, and the latter in the east. In the coastal regions the shoots and branches are chiefly attacked, especially on the Cellini variety. The best means of control is a thorough clearance of all diseased material; an application of strong lime-sulphur or copper sulphate immediately before flowering is also advisable in the case of *M. cinerea*.

Apple canker (*Nectria galligena*) is very prevalent in the Åkerø, Gravenstein, and White Transparent varieties growing in swampy,

cold, and heavy soils. It may be controlled by manuring with lime and phosphates, disinfection of the cankers and other wounds with coal-tar or carbolineum, and spraying before flowering with strong lime-sulphur or 3 per cent. copper sulphate.

Nectria cinnabarina, which occurs primarily as a saprophyte on dead wood, may cause damage to apples by spreading to live branches [see this *Review*, ii, p. 319]. All decayed material should be removed. Another fungus, probably *Cytospora leucostoma*, occurs on stunted branches and top shoots, the bark of which shows a dark brown discoloration and is readily detachable. Like *N. cinnabarina* it is a weak parasite, which first gains admission through wounds and then spreads to the healthy wood, and may be combated by the same measures.

Other apple diseases appear to be of minor importance, except bitter pit, which was severe on Torsteins and Gravensteins.

Pear scab (*Venturia pirina*) is particularly severe in the coastal districts on the Empress variety, which has been practically wiped out by the disease in Hardanger: the Grey, Amanlis, and Bonne Louise varieties are also susceptible, while Double Philip and Count Moltke are resistant. Spraying with lime-sulphur or 2 to 3 per cent. copper sulphate is recommended.

The pear bladder fungus (*Taphrina bullata*) produces yellow or brown protuberances on the leaves, the under side being covered with a white layer of asci. The fungus overwinters in the buds, and infects the developing leaves in the spring, causing stunting and malformation. Often the spots form more or less continuous stripes along the midrib. The disease is prevalent in the west, but seldom severe.

Brown rot of plums (*Monilia* (*Sclerotina*) *cinerea* f. *pruni* and *M.* (*S.*) *fructigena*), which primarily attacks the flowers and branches in the south-west and fruit in the east, may be controlled by the measures recommended under apples. The Victoria and Czar varieties are the most susceptible.

Plum pockets (*Taphrina* [*Exoascus*] *pruni*) occur in damp, cool weather on damsons, Yellow Egg, and Damask plums. It may be controlled by a dormant spray of 2 to 3 per cent. copper sulphate or strong lime-sulphur or an application immediately before flowering of lime-sulphur at summer strength or 1 per cent. Bordeaux mixture.

Witches' brooms of plums, caused by *Taphrina* [*Exoascus*] *insititiae*, are occasionally recorded. The asci form a greyish-white layer on the under side of the stunted and distorted leaves. The only method of control is the excision of the brooms during the winter.

Silver leaf (*Stereum purpureum*) is of very general occurrence on plums, especially the Victoria and Czar varieties. The disinfection of all wounds and the excision of dead material are the best control measures.

Thecopsora areolata (*Pucciniastrum padi*), which is very prevalent on the bird cherry [*Prunus padus*], occurred on Morello cherries in 1922. This is believed to be only the second case of infection reported on this host. The alternate stage of the fungus occurs on spruce cones.

Monilia (*Sclerotinia*) *cinerea* f. *pruni* causes extremely severe damage to both sweet and Morello cherries, especially in densely planted orchards and on damp, acid soil. The Mayberry, Früheste der Mark, Yellow Spanish Morello, and Ostheimer varieties are very susceptible. Good results in the control of the disease were obtained by winter spraying with 2 per cent. Bordeaux mixture or copper sulphate.

Rust (*Puccinia ribis*) is extremely severe on red currants in some of the coastal regions, but is easily controlled by the removal of dead material and spraying before flowering with lime-sulphur or 1 per cent. Bordeaux mixture. *P. caricis* (*P. pringsheimiana*) is also known to occur on red currants, though in a much milder form than on gooseberry. It was reported on black currants in 1921, which appears to be only the second report on this host. It usually overwinters on *Carex goodenoughii*. *Caeoma ribesii* has been observed on red currants, as well as on gooseberries, *Ribes alpinum*, and *R. pubescens*. The fungus overwinters on various species of willow, chiefly *Salix viminalis*, which should not be grown in proximity to red currant plantations. *Cronartium ribicola* and *Sphaerotheca mors-uvae* were also reported on red currants, the latter causing considerable damage on the Raby Castle variety.

Leaf spot (*Septoria* (*Mycosphaerella*) *ribis*) was prevalent on red and black currants and gooseberries. The application of lime-sulphur, 1 per cent. Bordeaux mixture, or sulphur dust with arsenate, beginning just before flowering and continuing, if necessary, at intervals of three weeks, is recommended.

Gloeosporium ribis, causing defoliation of red and black currants and gooseberries, especially near the coast and in damp seasons, may be controlled by the measures applicable to leaf spot. The Red Dutch Grape variety is comparatively resistant.

Leaf scorch, characterized by the desiccation and brown discoloration of the leaf edges, was very prevalent on red currants, being observed also to a smaller extent on black currants and gooseberries. On the last-named the marginal discoloration is greyish. The phenomenon is in most cases attributable to excessive transpiration, which in its turn is correlated with unsuitable soil conditions. The application of organic manure, compost, lime, or potassium has been found beneficial in various instances. Exposure to sun, wind, or smoke injury may also produce similar effects to those described above, while *Botrytis cinerea* is occasionally involved.

Cronartium ribicola, which is found on black currants wherever the Weymouth pine (*Pinus strobus*) is grown, can be eradicated only by felling the trees within a radius of several hundred yards. *P. flexilis* and *P. cembra* appear to be less susceptible. *Gloeosporium ribis* was most severe on the Lees Prolific and Boskoop Giant black currants, Bang Up, Goliath, and Edina being relatively resistant. An obscure black currant disease, the symptoms of which resemble those of 'nettlehead' or 'reversion', has been reported from several western districts, chiefly on the Boskoop Giant and Bang Up varieties.

American gooseberry mildew (*Sphaerotheca mors-uvae*), a detailed account of the origin and spread of which is given, attacks

principally the modern, large-berried gooseberries such as Yellow Lion and Whinham's Industry. The results of experiments [full particulars of which are given] in the control of the disease, carried out in 1922, showed that the various sulphur preparations (lime-sulphur, supersolfo, solbar) were more reliable than Bordeaux mixture, formalin, or sodium chloride. Three applications (one dormant and two summer) are recommended. European mildew (*Microsphaera grossulariae*) seldom causes any appreciable damage to gooseberries in Norway. It may be controlled in severe cases by one or more applications of lime-sulphur.

Raspberry cane blight (*Didymella applanata*) appears to be increasing in virulence. Thorough ventilation and spraying with 3 per cent. copper sulphate before the buds open and 1 per cent. Bordeaux mixture before flowering should reduce the incidence of the disease.

Mosaic and leaf roll occur both on wild and cultivated raspberries; the eradication of infected individuals is recommended.

Strawberry mildew (*Sphaerotheca humuli*) is only known to occur in the *Oidium* stage and seldom causes much loss. The Deutsch Evern variety appears to be very susceptible. *Botrytis cinerea* causes severe damage to Abundance strawberries under damp conditions, which should be avoided as far as possible. Strawberry leaf spot (both *Mycosphaerella fragariae* and *Mollisia earliana* are reported) is prevalent but not serious.

A reddish discoloration and curling of strawberry leaves has been very common during the period under review, especially on the Deutsch Evern variety on marshy ground. The cause of the disease is still obscure.

SALMON (E. S.). **Economic mycology.**—*Journ. South-Eastern Agric. Coll., Wye, Kent*, 23, pp. 13–33, 1923.

The spread of wart disease of potatoes [*Synchytrium endobioticum*] is assuming a serious character in Surrey, where 34 localities are involved. In Kent, where it first appeared in 1914, it has been found in 12 districts, while Sussex has experienced only two outbreaks so far.

Satisfactory control of gooseberry mildew [*Sphaerotheca morsuvae*] is stated to be now commonly secured in Kent by thorough spraying in April or May with lime-sulphur. When this fungicide is used against the Erysiphaceae it is generally advisable to add a 'spreader', especially in hand, as opposed to power, spraying, and calcium caseinate is recommended for the purpose. The suggestion is made that commercial lime-sulphur should be standardized on the basis of the percentage of calcium polysulphide present, as the other constituents, sulphate, sulphite, thiosulphate, and hydroxyhydrosulphide, of calcium, have been shown to be devoid of fungicidal properties.

Among the rarer fungous diseases encountered during the period under review (1914 to 1922) [not previously noticed in this *Review*] were the following: A disease of Spanish chestnut [*Castanea vulgaris*], apparently identical with ink disease [see this *Review*, iii, p. 245], caused by a species of *Melanconis*. A die-back of cherry twigs and branches associated with a *Bacterium*. A wilt of

tomatoes associated with a fungus which forms sclerotia on the roots. A destructive disease of young pear trees, probably due to *Roesleria pallida*. *Armillaria mellea* spreading from rotting tree trunks to apple trees, brambles [*Rubus*], and docks [*Rumex*], the apples being killed. *Exobasidium rhododendri* producing galls on *Azalea* bushes. A bacterial disease of mulberry.

Results of considerable practical value in the spraying of plants against fungous diseases have been obtained by a series of experiments in the preparation and application of liver of sulphur (potassium polysulphide), ammonium polysulphide, lime-sulphur, lime-sulphur combined with lead arsenate, and a copper emulsion (0·4 per cent. copper sulphate and 2 per cent. soap) which gave promising results in the control of potato blight [*Phytophthora infestans*] but cannot yet be generally recommended owing to certain disadvantages. The results of most of these experiments have been published in the *Journ. Agric. Science* and *Journ. Min. Agric.* from 1916 onwards.

A summary is given of various other investigations carried out at Wye during the period from 1914 to 1922, the results of which have already been published.

Nicholls (H. M.). **Report of the Government Microbiologist.**—*Ann. Rept. Tasmania Agric. & Stock Dept. 1922–23*, pp. 15–17, 3 figs., 1923.

On the whole, the incidence of potato diseases was comparatively light during the period under review. Irish blight [*Phytophthora infestans*] still occurs in the colder and wetter districts. Silver scurf (*Spondylocladium atrovirens*) was extremely common, especially on the north-west coast, but not serious.

During the last few years the shot hole disease of apricots (*Coryneum beijerinckii*) has caused very extensive losses and greatly weakened the trees in affected orchards. The fungus appears to introduce some poison into the leaves which results in the defoliation of even slightly affected trees. Similar effects have been noticed in the case of leaf spot of apple trees (*Sphaeropsis malorum*) [*Physalospora cydoniae*]. Shot hole of apricots can be adequately controlled by a lime-sulphur (1 in 7) application just before the rising of the sap in spring, and by strict attention to sanitation.

A fungus, which was identified at Kew as *Corticium fuciformis*, has been found attacking grass in patches in the Deloraine district.

Tomato wilt (*Fusarium* sp.) has been much in evidence. There is some evidence to show that the disease is seed borne, and in some cases a species of *Fusarium*, indistinguishable from that found in diseased plants, developed in cultures made from the seeds. Good results were obtained in the control of the disease by regular spraying with Bordeaux mixture. It is thought that the immersion of the seed in a weak solution of formalin would also prove beneficial.

Edgerton (C. W.). **Department of Plant Pathology.**—*Thirty-fourth Ann. Rept. Louisiana Agric. Exper. Stat. for 1922*, pp. 17–18, 1923. [Received 1924.]

Investigations on the control of mosaic disease of sugar-cane are

in progress at the Audubon Park Sugar Experiment Station, New Orleans. For several years the work has been directed towards procuring resistant strains. The selected strains in the mosaic plots produced 2 to 4 tons more per acre than the unselected. Experiments with the highly resistant L–511 variety have shown that healthy seed of this cane can readily be selected at planting time with a resulting 10 to 15 per cent. increase of tonnage.

Investigations on the root rot of maize have been continued. The principal work in 1922 consisted of testing out 200 ears of maize for germination, yield, and the presence of root rotting organisms in the seed. The possibility of the early field selection of maize for seed is also being investigated.

Excellent results have been given by the use of the special Louisiana tomato varieties selected for resistance to wilt [*Fusarium lycopersici*]. These varieties yield 2 to 3 more tons per acre than any others, and are being extensively distributed to growers all over the State.

Thirty-sixth Annual Report of the Nebraska Agricultural Experiment Station for 1922. 96 pp., 10 diag., 1923. [Received 1924].

Investigations on the viability of the potato blackleg organism *Bacillus phytophthorus* [*B. atrosepticus*] under varying conditions of temperature and moisture showed it to be very susceptible to desiccation. At 100 per cent. relative humidity it was found to remain viable for at least 8 days at a temperature range of 5° to 30° C., at 90 per cent. humidity with a temperature of 25° viability lasted only 3 hours, while at 80 per cent. with the same temperature the organism lived only 1 hour. Inoculation experiments on tubers showed that at the optimum temperature for infection no decay occurred at humidities of 40 per cent. and under. The decay of stored tubers caused by it should, therefore, be readily controllable by low temperatures and low humidity in ordinary storage cellars.

Other investigations carried on at the Station have already been separately noticed.

Patologia vegetal e instrucciones sobre destrucción de parásitos vegetales y animales de las plantas. [Plant pathology and advice on the extermination of vegetable and animal plant parasites.]—*Mem. Inst. Biol. Soc. Rural Argentina, 1922–23*, pp. 48–49, 1923.

The following parasitic diseases occurring in the Argentine Republic were reported upon by the Institute at Buenos Aires during the period under review, fruit trees being the chief sufferers. *Exoascus deformans*, *Puccinia pruni* [*-spinosae*], sooty moulds, crown gall, &c., on peach; *Fusicladium pirinum* on pear branches; *F. dendriticum* and sooty moulds on apple; *Plasmopara viticola*, *Uncinula necator*, and *Gloeosporium ampelophagum* on the vine; *Exoascus deformans* [? *E. pruni*] and *Coryneum beijerinckii* on plums; *Uredo fici* on figs; *Microstroma juglandis* on walnuts; gummosis and sooty moulds on citrus; *Melampsora lini* on flax; rust (*Puccinia*) on oats; smut (*Ustilago tritici*), bunt (*Tilletia*

tritici), and rust (*Puccinia*) on wheat; *Peronospora trifoliorum* on lucerne; *Ustilago bromivora* on brome grass; *Sphaerotheca pannosa* and *Phragmidium subcorticium* on roses; *Oidium euonymi-japonici* on *Euonymus japonicus*; *O. quercinum* on oak; *Melampsora populina* on Carolina poplar; *Stereum atrozonatum* on weeping willow [*Salix*]; *Erysiphe polygoni* on pumpkins.

WELLES (C. G.) & ROLDAN (E. F.). **Another economic host of Bacterium solanacearum.**—*Phytopath.*, xiii, 11, pp. 488–491, 1 fig., 1923.

Tañgo (*Chrysanthemum coronarium*) plants at Los Baños, Philippine Islands, were seriously affected by a wilt disease in February 1921. By the end of three months all the plants (the species is extensively cultivated in the Philippines, India, China, and the Pacific Islands as a pot-herb) were nearly or quite dead.

The disease was found to be caused by an organism closely resembling *Bacterium solanacearum*, which produced similar symptoms in comparative inoculations with both organisms on tomato seedlings. The one constant variation was in the production of pigment, which, in the first season, was much lighter in colour than that formed by *Bact. solanacearum* from Solanaceous hosts. In the second season this difference was not so marked. The group number of the tañgo organism, the rods of which measure 1·22 by 0·42 μ, is 2–·3333823.

COOK (M. T.). **Early stages of crown gall.**—*Phytopath.*, xiii, 11, pp. 476–480, 14 figs., 1923.

The results of a study of the incipient stages of crown gall [*Bacterium tumefaciens*] on castor oil plant [*Ricinus communis*] seedlings and *Bryophyllum*, inoculated with the organism by means of a longitudinal slit extending to the pith and filled with the organisms from cultures, showed that the galls start as more or less spherical masses in the particularly susceptible parenchyma cells. The reaction to the gall differed from that displayed in response to wounding and resulting in the formation of callus. The organism evidently exerts a considerable influence in the cells with which it is in contact.

The first reaction definitely attributable to *B. tumefaciens* occurred not in the cambium as is the case with most plant galls, but in the cortex or the outer part of the medullary rays, i. e. between the phloems of two adjacent fibro-vascular bundles, the xylem of which may be distorted as the result of pressure exercised by the growing gall tissues but does not take part in the formation of the gall. The affected portion, which consisted of a 'nest' or 'whorl' of gall cells, was in close contact with the cambium and slightly removed from the point of inoculation. The tracheids and spiral tubes appearing in the galls seem to be developed *de novo* from the homogeneous parenchyma mass of the incipient gall. Strands of tumour tissue were easily seen in the pith and cortex, the latter apparently developed from cortical and cambium cells, but always situated between two phloem groups. The cells of the incipient gall are parenchymatous, rich in protoplasm, and uni-

nucleate. Apparently any meristematic tissue can respond to the stimulus of the organism.

Quirk (Agnes J.) & Fawcett (Edna H.). **Hydrogen-ion concentration versus titratable acidity in culture mediums.**—*Journn. Infect. Dis.*, xxxiii, 1, pp. 1–59, 10 diag., 1 col. chart, 1923.

Provided that a uniform method be used in the preparation of peptone beef infusion broth, titratable acidity as measured by the older methods can be interpreted in terms of P_H values. Beef extract is unsuitable on account of its variable composition.

The formulae advanced for the translation of Fuller's scale values into P_H values and vice versa are as follows:

I. Given any Fuller's scale value, to find the P_H value. Let F be the given Fuller value, then $8{\cdot}2 - \frac{F}{10} = P_H$.

II. Given any P_H value, to find the Fuller's scale value. Let P_H represent the P_H value, then $10\,(8{\cdot}2 - P_H) = F$.

The beef infusion should be prepared either (*a*) cold, by adding water equal to twice the weight of the beef; or (*b*) hot, by adding water equal to 2·5 times the weight of the beef.

In obtaining P_H equivalents for Fuller's scale values the first faint but distinct pink reaction must be chosen as the end point. The necessity for a consistent choice of colour in determining the end point in phenolphthalein titrations can hardly be over-emphasized. A deep pink should never be used. In the chart used by the writers the faint but decided pink reaction (P_H 2·2) is about half as deep as Ridgway's ('Color Standards') Cameo pink, and rose pink (P_H 8·4) is about equal to his Venetian.

In order to reach any given scale in autoclaved beef infusion broth, an excess amount of alkali above the calculated quantity must be added to compensate for the loss due to the buffer effect of the broth and the changes brought about by heating. The titration curve actually given in sterilized media does not coincide with the theoretical titration curve calculated on the number of cubic centimetres of alkali added. Within the limits defined by +30 and −10, any Fuller's scale value thus calculated will have an approximate P_H equivalent.

Additions of large amounts of alkali to beef infusion cause markedly unstable media, which gradually become more acid on standing after sterilization. This is equally true whether the reaction is measured by titration or P_H determination.

So far as tested, the relation between the scales expressed in the formulae given above holds good for all standard media based on a one per cent. peptone beef infusion, with the exception of gelatine in the extreme ranges, especially on the acid side.

When one per cent. Eimer and Amend's powdered agar is added to peptone beef infusion broth, the agar may be adjusted with practically the same resulting reactions (Fuller's scale and P_H) as obtained for the broth alone. One per cent. agar does not solidify firmly when autoclaved in the presence of more than 10 c.c. normal HCl per litre (giving a P_H value of 5·2 to 5·4), but will stand 60 c.c. of normal NaOH (giving a P_H value of about 9·8). The addition of ten per cent. Nelson's photographic gelatine No. 1 to the broth exerts

a considerable buffer effect, and the formulae for transference of values can be applied only between zero and +20 Fuller's scale. The tests made showed that ten per cent. gelatine broke down after sterilization by steam at about the same P_H in the acid range as the agar, but did not tolerate as much alkali, breaking down at 60 c.c. normal NaOH per litre or P_H 9·4.

The greatest degree of acidity tolerated by any organism tested was +44 Fuller's scale (P_H 4·3) in *Bacillus* sp. from iris and *Bacterium marginatum*, and the greatest degree of alkalinity was −22 Fuller's scale (P_H 9·4) in *Bacillus aroideae*; *B. apiovorus*, *B. carotovorus*, and *Bacterium malvacearum*. The average of the mean optima for all the organisms tested [details of which are given] was +11·3 Fuller's scale and P_H 7·05. Thus the correction of beef broth to H-ion neutrality (P_H 7·0) or +12 Fuller's scale leaves the medium at a point favourable to the growth of the majority of plant pathogenic bacteria, and the old established custom of adjusting beef broth to a point slightly acid to the phenolphthalein (+10 to +15) appears justifiable.

JONES (L. R.), WILLIAMSON (MAUDE M.), WOLF (F. A.), & MCCULLOCH (LUCIA). **Bacterial leaf spot of Clovers.**—*Journ. Agric. Res.*, xxv, 12, pp. 471–490, 6 pl., 3 figs., 1923. [Received 1924.]

Since 1916 a hitherto undescribed bacterial leaf spot disease has been observed on *Trifolium pratense*, *T. medium*, *T. repens*, *T. repens* var. *latum*, *T. hybridum*, *T. incarnatum*, *T. alexandrinum*, and *T. pannonicum*. It is known to occur in Wisconsin, Iowa, Indiana, Virginia, Maryland, and North Carolina, and is probably widely distributed.

The most conspicuous symptoms of the disease appear on the leaves, though stems, stipules, petioles, and flower pedicels are also attacked. The presence of minute, translucent dots on the lower leaf surface is the first indication of infection, which may occur throughout the growing season. The lesions enlarge, becoming angular and sharply delimited by the veins. The centres turn inky black, while the margins retain their water soaked appearance. Severely spotted leaves become distinctly chlorotic and are liable to premature shedding. Large, irregular, dead areas may be formed on them and the central parts of old lesions often become torn or fall out. Under very humid conditions a milky white, bacterial exudate, which, on drying, becomes a delicate, encrusting film, is formed on the lower leaf surface.

The morphological and cultural characters of the causal organism, to which the name *Bacterium trifolium* n. sp. has been given, are described. The pathogen is flagellate, produces whitish colonies on nutrient agar, forms acid from dextrose and saccharose, and grows well at a wide range of temperature. Its optimum temperature in bouillon was found to be 26° C. and in agar 18° to 21°, the minimum and maximum being 3° and 34° respectively. The thermal death point is between 48° and 49° C. The organism proved highly susceptible to desiccation. Its viability on the usual culture media appears to be of indefinite duration; a culture has been maintained on potato agar without appreciable loss of vigour for over four years.

With the type strain from Wisconsin infection was secured only on red clover, but with the North Carolina and Virginia strains successful reciprocal inoculations were made on red, white, and alsike clover. Lima beans (*Phaseolus lunatus*) and velvet beans (*Stizolobium deeringianum*) were also infected by the Virginia strains. The parasite is intercellular and apparently enters chiefly through the stomata.

It seems highly probably from field observations that the disease is transmitted by the seed and disseminated through the agency of rain or dew and leaf-eating insects, especially the larvae of the clover leaf weevil, *Phytonomus punctatus*.

HASKELL (R. J.) & WOOD (JESSIE I.). **Diseases of cereal and forage crops in the United States in 1922.**—*Plant Disease Bull. Supplement* 27, pp. 164–265, 38 maps, 1923.

This annual review of the diseases of cereal and forage crops in the United States in 1922 has been prepared on the lines adopted in previous reports of a similar nature [see this *Review*, i, p. 424].

Most of the diseases reported as (*a*) new, (*b*) occurring for the first time in certain localities, and (*c*) found on new hosts, have already been noticed in this *Review*. Special importance is attached to the following on account of their potential virulence and the possibilities of widespread dissemination. Flag smut of wheat (*Urocystis tritici*) [see above p. 253], the area of known infestation with which has increased from 72 to 700 sq. miles; *Sclerotium* disease of wheat (*S. rhizodes*) [see below, p. 267]; head smut of maize (*Sorosporium reilianum*), occurring in Washington and California; mosaic of maize, reported from Arkansas in 1922 and previously recorded in other southern States; bacterial stalk rot of maize [see this *Review*, i, p. 170]; and powdery mildew of clover (? *Erysiphe polygoni*) [see this *Review*, iii, p. 214]. The identity of the last is still doubtful, and it is considered to be not unlikely that another species or strain is involved than that usually found on clover in the United States.

In connexion with the well authenticated evidence that *Tilletia levis* is the chief causal organism of bunt of wheat east of the Rocky Mountains and *T. tritici* in the much smaller area of the western districts, R. S. Kirby states (1922) that *T. tritici*, introduced into New York from Washington State in No. 4 wheat, is rapidly disappearing without any treatment. The increase in the incidence of bunt in Montana, Idaho, Washington, and Oregon may possibly be explained, to some extent at least, by the abnormally low temperatures prevailing in that region during the sowing of winter wheat in September 1921. The work of Hungerford [see this *Review*, ii, p. 13] and C. O. Johnston (*Phytopath.*, xiii, p. 36, 1923) on the temperature relations of the disease is believed to support this theory. Johnston states (loc. cit.) that the Kanred variety, while apparently resistant to *T. tritici*, is susceptible to *T. levis*.

The greatest losses from loose smut and leaf rust of wheat (*Ustilago tritici* and *Puccinia triticina*) occurred in the soft red winter wheat belt.

Stem rust of wheat (*Puccinia graminis*) was definitely observed

to overwinter in southern Texas, and is believed to have done so in the north of the State also. The earliest date on which the disease appeared on cereals and grasses in the barberry eradication area was 22nd May (Nebraska) and the latest 23rd June (Montana). At Northfield, Minnesota, on 6th June, 25 to 100 per cent. of infection was found on all plants $\frac{3}{4}$ mile distant from barberry plantings, while the disease was subsequently traced three miles away. The consensus of available information on the epidemiology of stem rust in the northern spring wheat area indicates that infection is principally disseminated by barberries, though southern-blown spores may also contribute in a secondary degree to late contaminations.

Large numbers of spring and winter wheat plants at Lincoln, Nebraska, showed symptoms of mosaic, and preliminary inoculation tests with the juice of infected individuals gave some positive results.

A new disease of flax, similar to or identical with that known in South America as 'pasmo' and caused by *Phlyctaena linicola* Speg., has been noticed for four years in North Dakota and was found on fibre flax in Michigan during 1922. Varietal susceptibility is stated to be very marked. A species of *Rhizoctonia* has caused severe damage to flax plants in eastern North Dakota.

Leaf spot of clover (*Sphaerulina trifolii* Rostr.) was described, for the first time in the United States, as occurring in Missouri, Illinois, and New York, principally on white clover [*Trifolium repens*], but also on the red [*T. pratense*] and alsike [*T. hybridum*] varieties.

Soy-beans were attacked, for the first time recorded in the United States, by a downy mildew due to *Peronospora* sp. Velvet beans [*Stizolobium deeringianum*] in South Carolina were affected by a leaf spot (*Cercospora stizolobii* Syd.).

The above are only a few of the many interesting records and observations included in this report.

Gulrosten på Höstvetefalten. [Yellow rust in the autumn Wheat fields.]—*Landtmannen*, vii, 31, pp. 548–549, 1923.

Speaking at a meeting of the Malmö [Sweden] Agricultural Club, Prof. Nilsson-Ehle referred to the extraordinary damage to wheat caused by yellow rust [*Puccinia glumarum*] in the south of Skåne during 1923. A remarkable feature of the attack was the susceptibility of the well-known resistant variety Pansar II, while Pansar III, Riddar, Standard, Fulgia, and Sol II (the two last-named normally somewhat susceptible), were comparatively immune. It was pointed out that since 1900 there had been severe epidemics of yellow rust about every five years in the region in question. During 1923 the cold spring and early summer undoubtedly contributed to the spread of the disease.

Another curious feature of the 1923 attacks was their irregularity, severely infected patches being found in the midst of otherwise healthy fields. The inconsistent behaviour of Pansar II and other varieties is thought to be due to differences of reaction to the disease under differing weather conditions, these latter acting chiefly by influencing the development cycle of the variety. The

normal cycle of development of Pansar II and Fulgia, for instance, differs widely, and it is possible that the 1923 attack caught the former at a particularly susceptible phase of growth. Possibly also different biologic forms of the fungus are favoured by particular meteorological conditions, and this may have something to do with the facts observed. It is highly improbable that Pansar II should suddenly have lost its resistance to *P. glumarum*, but it is evident that there is a certain instability of these varietal differences, and attempts to remedy this by continued selection should be made.

At a meeting of the Swedish Seedsmen's Association, Åkerman referred to the same phenomenon of the behaviour of Pansar II in regard to yellow rust in 1923. The variety showed a precocious development and an extremely luxuriant growth which seems to have predisposed it to the disease. The winter was unusually mild and the spring cold and wet. He expressed somewhat similar views in regard to the fluctuations of varietal resistance to the disease as those outlined by Nilsson-Ehle, and discussed the relation of early and late sowing to this aspect of the rust problem [see this *Review*, i, p. 11].

HUNGERFORD (C. W.) & OWENS (C. E.). **Specialized varieties of Puccinia glumarum, and hosts for the variety tritici.**—*Journ. Agric. Res.*, xxv, 9, pp. 363–401, 6 pl., 1923.

As a result of the investigations made in the period 1918 to 1920, stripe rust (*Puccinia glumarum*) has been found in the field on wheat, barley, rye, spelt, and emmer, as well as on 33 species of wild grasses, in the western part of the United States. The most commonly distributed specialized form is *P. glumarum tritici*, while field observations indicate that *P. glumarum hordei* also occurs. Inoculation experiments showed that the former from wheat will also infect rye moderately, barley slightly, and 47 species of wild grasses, including 19 species of *Bromus*, 11 species of *Agropyron*, 7 each of *Hordeum* and *Elymus*, and one each of *Hystrix*, *Phalaris*, and *Sitanion*. In the field, stripe rust has been collected on twelve more grass hosts, but it has not yet been determined whether these grasses can also be infected by the specialized variety from wheat. There is some indication that there exist strains in different grass species reacting differently to the same variety of rust, and that there are two or more specialized races of *P. glumarum tritici*.

Some details are given of a series of experiments made at Corvallis, Oregon, during the same period of three years, in which 163 named varieties and strains of wheat were tested for rust resistance in a rust nursery and 92 varieties were similarly tested in the greenhouse. The results, given in tabular form, agreed quite closely in both series except for a few varieties. A very marked difference in the susceptibility to the rust was noted amongst these varieties, a larger number of which appear to be resistant to stripe rust than to stem rust. Resistance to the two rusts does not coincide. Thus Khapli, resistant to all forms of *P. graminis*, is not specially resistant to *P. glumarum*. Comparatively few of the varieties tested became infected in the ears under the conditions of

the experiments, but when ear infection resulted, the yield in grain was greatly reduced. Leaf infection was more severe in the seedling stage in spring-sown wheat, while for wheat sown in autumn it was more severe at the time of heading. In a few cases teleutosori were formed on wheat seedlings in the greenhouse.

Several varieties of wheat were found to be very resistant to the strains of rust studied. Resistance was evidenced by the development of large areas of dead tissues in the inoculated portions of the leaves, sometimes followed by the production of a few uredosori. In certain grass hosts inoculated, dark brown blotches developed around the inoculated areas; this appears to be specific for these grasses and is not considered a general sign of resistance.

HUNGERFORD (C. W.). **A serious disease of Wheat caused by Sclerotium rhizodes in Idaho.**—*Phytopath.*, xiii, 10, pp. 463–464, 1923.

Early in 1922 specimens of winter wheat, affected by a disease stated to be causing considerable damage in the field (up to 50 per cent.), were submitted to the Moscow (Idaho) Experiment Station for examination. The diseased plants were covered with dark brown or black bodies (stated in the reports to have been originally yellow or brown) which were identified as the sclerotia of *Sclerotium rhizodes*, recorded in a similar form from Montana in 1907. The disease occurred in spots, killing the majority of plants in the affected area, on the margin of which and scattered throughout the field were less seriously infected individuals.

ROSEN (H. R.) & ELLIOTT (J. A.). **Pathogenicity of Ophiobolus cariceti in its relationship to weakened plants.**—*Journ. Agric. Res.*, xxv, 8, pp. 351–358, 5 pl., 1923.

In 1921 *Ophiobolus cariceti* was found in Arkansas in two fields on wheat growing on poor and badly drained soil with an acid reaction, the following grasses being also attacked: *Festuca elatior*, *F. octoflora*, *Bromus secalinus*, and *Hordeum pusillum*. It was also found on unthrifty plants of perennial foxtail (*Chaetochloa geniculata*) growing in a few water-logged areas on the grounds of the University of Arkansas; as no wheat has ever been grown on these grounds, there is every reason to believe that the fungus is endemic on this native grass. Field observations indicated that infection was confined to weakened plants. Lack of proper nutrients and water-logging of the soil in particular appeared to be conducive to attacks by this fungus. In order to test this, an experiment was carried out in 1922 on one of the diseased fields, involving the use of lime, farm manure, and commercial fertilizers of a 4–8–3 formula. Counts made on 8th June, when the heads were almost mature, gave the following percentage of infection: control plot (untreated) 80 per cent.; manure plot 45 per cent.; commercial fertilizer 7 per cent.; lime 95 per cent. The average yields per acre were: untreated plot 4 bushels, manure plot 14·3 bushels, and commercial fertilizer 18·4 bushels, while the lime plot was a total failure. It was thus found that the commercial fertilizer almost completely eliminated the disease, the manure

considerably reduced it, while lime increased the incidence of infection.

It is therefore concluded that *O. cariceti* confines its attacks to weakened plants, and its discovery in New York, Oregon, Indiana, and Arkanas suggests that it is present over a wide range of the country but has been overlooked because of its slight economic importance.

MAINS (E. B.) & LEIGHTY (C. E.). **Resistance in Rye to leaf rust, Puccinia dispersa Erikss.**—*Journ. Agric. Res.*, xxv, 5, pp. 243–252, 2 pl., 1923.

Experiments [details of which are given] conducted at Purdue, Indiana, from 1920 to 1922, resulted in the production of plants showing a high degree of resistance, sometimes amounting to practically complete immunity, to leaf rust of rye (*Puccinia dispersa*).

Although none of the 68 selections and varieties of rye studied was uniformly resistant, all showed a few individuals attaining a high degree of resistance. Crosses made by bagging together heads of two highly resistant plants showed gradations in the susceptibility through intermediate grades of resistance to complete immunity.

The data obtained are not sufficient to justify conclusions as to the type of inheritance in rye of resistance to leaf rust, but it is believed that resistance is a dominant quality. Complicating factors are introduced, however, by the production of many intermediate types.

MASON (T. G.). **Ligneous zonation and die-back in the Lime (Citrus medica, var. acida) in the West Indies.**—*Sci. Proc. R. Dublin Soc.*, xvii, N.S., pp. 25–31, 4 pl., 1923.

In this paper the author gives the results of an examination of the ligneous zonation of a number of lime (*Citrus medica* var. *acida*) shoots from trees growing in different parts of the West Indian islands of Dominica and Montserrat. Of the shoots collected half came from trees affected with die-back.

Rather definite evidence of periodicity in the activity of the cambium was found, marked by the occurrence of tangential zones of parenchyma distributed within the more porous zone of vessels. These are interpreted as being the result of a temporary desiccation of the cambium due to recurring droughts, which are especially liable to occur during the period of maximum vegetative activity, when under normal conditions there is usually no more than barely sufficient soil moisture. Temperature fluctuates little in these islands and is not a probable factor in the zonation, but the strong trade winds produce a desiccating effect during the dry months of the year and help to disturb the water balance of the plant at recurring drought periods. In those localities in which the aridity of the plant's environment fluctuated most rapidly, the parenchyma bands were most pronounced, and it is in these areas that die-back of the lime trees is most conspicuous. It would seem that the rapid and repeated desiccation of the meristems, which is indicated in the case of the cambium by the development of

parenchymatous bands, results in the premature loss of dominance of the apical bud over the lateral buds, as a result of which the mother shoot dies back and is replaced by daughter shoots. Normally the decline, when once initiated, continues and the tree dies branch by branch. The evidence obtained indicates that the lime can withstand relatively dry conditions if they are initiated slowly, but cannot meet a rapid desiccation of its tissues.

TANAKA (T.). **Citrus scab in Japan.**—*Phytopath.*, xiii, 11, pp. 492–495, 1923.

Although citrus scab is believed to have existed in Japan from very ancient times, the first scientific account of it was given by Nishida [*Journ. Agric. Soc. Japan*, xxxvi, 1903 (Japanese)], who gives *Cladosporium citri* as the causal organism. Yoshino [*Bot. Mag. Tokyo*, xxxviii, 1903 (Japanese)] also attributed scab to *C. citri*, while Shirai ascribes it to *C. elegans*. Considerable confusion appears to exist between scab and canker. References to various early botanical works in Japanese and Chinese are given.

Citrus scab is distributed throughout Japan, but with very unequal severity. The citrus groves in the Ehime prefecture, for instance, show very little severe infection, while certain orchards only 30 miles away, in Oita, are heavily attacked. The disease is stated to be prevalent also in Formosa and Bonin.

WINSTON (J. R.), FULTON (H. R.), & BOWMAN (J. J.). **Commercial control of Citrus stem-end rot.**—*U.S. Dept of Agric. Circ.* 293, 10 pp., 7 graphs, 1923.

Stem-end rot of Florida oranges and grapefruit (caused by either *Phomopsis citri* or *Diplodia natalensis*), the symptoms of which are briefly described, may be controlled by the following measures. Thorough pruning of the dead wood from April to November, which is particularly effective where *Diplodia* is the predominant cause of the decay; spraying the young fruit once or twice with 3–3–50 Bordeaux mixture plus 1 per cent. oil as emulsion [see this *Review*, iii, p. 219] during April or before 5th May, as required for the control of melanose; removal of stem buttons by gassing (exposure of the fruit for 36 hours to the vapour from a gasoline [petrol] engine exhaust or kerosene oil stove with imperfect combustion, the temperature of the room ranging from 80° to 85° F., with 85 to 90 per cent. of humidity); and keeping the fruit at low temperatures, preferably between 40° and 45° F., the period between picking and consumption being curtailed as far as possible.

FURTADO (C. X.). **Coconut tapering disease.**—*Trop. Agric.*, lxi, 2, p. 126, 1923.

The tapering of coco-nut trees [see this *Review*, i, p. 163] described from Jamaica by F. S. Earle in *Journ. New York Bot. Gard.*, iv, p. 6, 1903, was associated in that island with the attacks of a scale insect, which did not, however, appear severe enough to account for the extensive damage done to affected trees.

The present writer states that in Burma most of the tapering trees observed by him occurred in undrained and neglected situations which were liable to flooding during the rains. The longest

leaves in many trees measured only about $1\frac{1}{2}$ yds. in length. The underground parts of two trees showed a decay of the boles from the butt upwards. Adjacent trees showed no sign of the disease which did not appear to be associated with any organism. The age of the affected trees was given as thirty to forty years.

McRae (W.). **I. History of the operations against bud rot of Palms in South India. II. Inoculation experiments with Phytophthora palmivora Butl. on Borassus flabellifer Linn. & Cocos nucifera Linn.**—*Mem. Dept. Agric. India*, Bot. Ser., xii, 11, pp. 21–70, 2 maps, 1923.

The first part of the present paper gives a summary of the work done to the end of 1909, and a detailed survey of the operations directed by the author during the period 1910–1921 to control the spread of bud-rot (*Phytophthora palmivora*) of Palmyra palms (*Borassus flabellifer*) in the Godavari and Kistna districts of Madras, India. For the sake of convenience the palms dealt with are divided into three categories, namely: (1) dead palms, in which the condition of the central leaf or group of leaves indicated that the growing point was dead; (2) outwardly infected palms, in which one or more of the leaves had characteristic rows of spots; and (3) inwardly infected palms, in which the presence of the disease was detected by stripping the leaf-bases from palms that showed no outward symptom but stood in the vicinity (within a radius of fifty yards) of dead or outwardly infected palms. The earliest attempt in 1906 to deal with the disease by cutting off and burning the infected tops accounted for 40,000 dead palms. From June 1907 to December 1908 398,000 dead palms were disposed of; it is thought probable that this number includes many trees that had died from about June 1904, as it has been established that it takes up to three years for all the leaves to wither, reckoning from the time the growing point dies. The intensity of the disease was greatest in 1908, when probably about 100,000 trees died; actually 183,000 were cut that year. The decline in the numbers destroyed was slow up to 1913, when 79,000 were cut, this being due to the gradual perfecting of the operations, to trees being cut more promptly, and to the area having been extended and better patrolled. Up to the end of 1912, 722,000 palm tops had been cut off and burnt. In 1913 the operations were extended by treating palms in the 2nd class (outwardly infected), 19,000 such palms being treated in that year by cutting away the diseased parts, and in 1914 treatment of inwardly infected palms on the same lines was commenced. From 1914 to 1917 there was a steady fall in the number of outwardly diseased and dead palms, owing to 74,800 inwardly infected trees having been treated and cured. Up to the end of 1921 the total number of palms destroyed by cutting and burning the tops was 956,446, and 131,693 more had the outwardly visible infected parts (the pinnae of the leaves) removed. From 1913 onwards 99,938 more diseased trees in the early stages of infection (when there were no visible external symptoms until the outer leaf sheaths were removed) had the diseased tissue cut away and were restored to health during the examination of 2,800,000 apparently healthy palms in the vicinity of dead ones.

In 1920 the Pest Act was applied, and the numbers dealt with in that year and in 1921, the last year of the operations under review, were only 16,000 and 8,000 respectively. Under the Pest Act the diseased palms are dealt with by the owner or occupier of the land, penalties being imposed for omission to do so.

As a result of the operations it can be confidently stated that the disease has been reduced from a grave menace to a controllable factor. The total cost from 1906 to 1921 has been roughly £20,000, the value of the palms 'cured' is about £28,000, and the number saved from infection cannot be calculated but must run into millions.

Outside the Godavari and Kistna districts, where the area infected is about 4,000 square miles, the bud-rot of Palmyra palm has been found in the South Kanara district on the West Coast and in the Hooghly district of Bengal. Only a few cases were observed in the former, which is not far north of the area in Malabar where coco-nut palms (*Cocos nucifera*) are also infected. On the latter the disease has also been found in the Chingleput district in North Arcot and in the Cochin and Travancore States, but is not common in the Godavari and Kistna districts, where coco-nuts are relatively scarce.

The chief factors of dissemination of the disease are tappers [persons who climb the trees to obtain the palm juice], the rhinoceros beetle (*Oryctes rhinoceros* Linn.), the rain splashing on the expanding infected leaves, together with occasional long-distance transport by human agency.

In the second part of the paper details are given of a number of inoculation experiments on both species of palms, which definitely show that *Phytophthora palmivora* can kill both the Palmyra and the coco-nut palm, that it can pass from the one to the other, and that all the symptoms of bud-rot are reproduced in both palms as a result of infection by the fungus. These experiments are regarded as completely meeting the criticisms of Sharples and Lambourne [see this *Review*, i, p. 173] regarding the cause of bud-rot of palms in India.

Crawford (R. F.). **Fungi isolated from the interior of Cotton seed.**—*Phytopath.*, xiii, 11, pp. 501–503, 1923.

The following organisms were isolated from cotton seed, obtained in 1921 from badly wilted plants at the Arkansas Experiment Station, after delinting with concentrated sulphuric acid, thorough washing, storing in a bag until the planting season, again charring with sulphuric acid, and treating for two minutes with 1 in 1,000 corrosive sublimate. All the organisms are believed to have come from the interior of the seeds, 1,469 of which were examined.

Colletotrichum (from 274 seeds), with which successful inoculations were made on healthy cotton bolls, producing the typical symptoms of anthracnose caused by *Glomerella gossypii*.

Diplodia gossypii (from 13 seeds, all dead), inoculation with which resulted in a jet-black, powdery coating of spores on punctured healthy bolls. The rot made rapid progress, destroying the lint of the entire boll. Following up a suggestion that the cotton and sweet potato species of *Diplodia* [the latter usually

referred to *D. tubericola*: see this *Review*, ii, p. 256] might be identical, sweet potatoes were inoculated with the organism from cotton with positive results. The sweet potatoes became dry, brittle, and coal-black internally, the typical pycnidia and bi-cellular brown spores being found on the surface.

Fusarium No. 1 (123 seeds), which produces a peculiar lemon-shaped, sporangium-like body and a very coarse mycelium, macroconidia being very scarce. On rice it forms dark brown colonies. No inoculation tests were conducted with this *Fusarium*.

Fusarium No. 2 (48 seeds) was apparently identical with that reported by Edgerton (*Louisiana Agric. Exper. Stat. Bull.* 137, 1912) as common on decaying bolls. It was isolated from spots on the leaves as well as from the interior of the seed. Inoculated bolls show a slight staining of the lint and may become entirely decayed. When planted, those that germinate develop spots on the cotyledons, and this *Fusarium* cotyledon spot appears to be quite common in the field. Preliminary injuries seem to be essential to boll infection.

Fusarium No. 3 (2 seeds) was described by Elliott (*Arkansas Agric. Exper. Stat. Bull.* 173, 1921) as causing a progressive pink rot of cotton bolls. Successful inoculation experiments were carried out on bolls in all stages of maturity.

Seven seeds gave a species of *Cephalothecium* and three an *Alternaria*, but no experiments were made with them.

Brown (J. G.) & Gibson (F.). **A new host for Bacterium malvacearum.**—*Phytopath.*, xiii, 10, pp. 455–457, 2 figs., 1923.

Pima-Egyptian cotton and also Arizona wild cotton (*Thurberia thespesioides*) were inoculated in 1922 with the angular leaf spot organism (*Bacterium malvacearum*). Positive results were obtained on both hosts, the symptoms, however, taking longer to appear in *Thurberia* than in *Gossypium*. The angular leaf spot organism was isolated from the infected areas. Shedding of the leaves in the wild cotton appeared to result from much less infection than in the cultivated varieties, but only one typical black arm lesion was found in the former, on a green twig.

Cook (O. F.). **Malformations of Cotton plants in Haiti. A new disease named smalling or stenosis, causing abnormal growth and sterility.**—*Journ. of Heredity*, xiv, 7, pp. 323–335, 6 pl., 1923.

A disease of cotton somewhat resembling the club-leaf or cyrtosis (*Journ. of Heredity*, xi, p. 99, 1920) occurring in China, but causing even greater extremes of reduction of the leaves and other organs, was observed in July 1923 in the north-central part of Haiti. The Meade variety, Sea Island, and American upland cotton were chiefly affected, the indigenous Haitian cotton being apparently immune.

The disease undoubtedly belongs to the general group of mosaic diseases and is characterized by the usual symptoms of the latter. The forms of distortion are very variable, one of the most characteristic being the development of large numbers of small flower-buds. Severe crippling is also frequent, while the torn or

eroded leaf margins and irregular scars or perforations of partially united tissues are reminiscent of the tomosis or leaf cut disease of young cotton in the United States. The only other disease or disorder of cotton in the United States hitherto recognized as possibly analogous to the Chinese and Haitian diseases is that known in the Salt River Valley of Arizona as 'crazy top' on account of the abnormal branching and sterility of the upper part of the plant.

The Haitian disease appears to be less influenced by external conditions than the Chinese form. There was no indication of recovery in the affected plants, which continued to grow abnormally even after the cessation of activity of the insect carriers which were evidently responsible for its distribution. The immunity of the Haitian cotton from the disease does not of course, debar it from acting as a host to the insect carriers and thus assisting in the spread of infection.

GENTNER (G.). **Bayerische Leinsaaten.** [Bavarian Flax seed.]—*Faserforschung*, iii, 4, pp. 277–300, 1923.

Bavarian flax, which now covers an area of 9,000 hect. and constitutes an industry of increasing importance, is subject to the following seed-borne diseases. A bacillus secreting a red colouring matter impairs the germination of the seed; it is stated to be probably identical with *Bacillus cerealium.* A species of *Alternaria* also reduces germination, while a *Fusarium* (probably *F. lini*, but with pale salmon-coloured, 5- to 8-septate spores instead of hyaline, 3-septate ones), causes considerable damage. Diseases caused by *Phoma* sp. and *Botrytis cinerea* are frequently observed.

On a few samples the author observed a fungus belonging to the genus *Helminthosporium*, the mycelium of which covers the seed. The conidiophores are septate, erect, not branched, often bent towards the tip, 7 to 8 μ thick, and blackish in colour. The conidia are oblong, broadest in the middle or at the base, frequently slightly crescent-shaped, olive-green to black, with 4 to 8 (generally 7 or 8) septa, 95·4 by 19·3 μ, isolated or in groups of two or three at the apex of the conidiophores. The fungus, which is believed to be a new species, is named *H. lini.*

Neither anthracnose (*Gloeosporium lini*) nor rust (*Melampsora lini*) has been identified with certainty in Bavaria.

Treatment of seed infected by *Fusarium* and *Phoma* by drying for three hours at 40° to 45° or heating for seven minutes at 60° to 80° C. caused a slight retardation of germination in the former case and a considerable delay (ten days) in the latter. The infection was reduced, but not entirely eliminated, by both treatments. Attempts to destroy the same organisms with formalin, alcoholic solution of corrosive sublimate, and carbolic oil were only partially successful. The attacks of *Penicillium*, moreover, were more severe on seed treated with formalin than on the untreated controls. The author believes that the best method of controlling these diseases is merely to preserve the seed for a few years, as it loses its viability very slowly and can safely be used for sowing after storage for five years. This method has already been shown to reduce the incidence of infection very considerably and is

decidedly to be preferred to the expensive and unreliable chemical treatments.

JONES (EDITH S.). **Taxonomy of the Sclerotinia on Helianthus annuus L.**—*Phytopath.*, xiii, 11, pp. 496–500, 1 fig., 1923.

The author undertook a series of experiments to elucidate the taxonomic position of the causal organism of the *Sclerotinia* wilt of sunflowers (*Helianthus annuus*) [see this *Review*, ii, pp. 304, 439], as to which the opinions of American pathologists are divided.

The fungus was isolated from diseased sunflower stalks and inoculated into young *Helianthus* and lettuce plants, in which the typical symptoms of wilt and drop were produced. The perfect stage, which was obtained from sclerotia from sunflowers over-wintered in quartz sand, was found to agree very closely with Fuckel's description of *Sclerotinia libertiana*, and there is no doubt that the American organism is identical with the latter fungus, which has been frequently stated to cause a similar disease of sunflowers in various European countries.

CUNNINGHAM (G. H.). **Black-rot (Physalospora cydoniae Arnaud).**—*New Zealand Journ. of Agric.*, xxvii, 2, pp. 95–102, 7 figs., 1923.

Black rot (*Physalospora cydoniae*) (*Sphaeropsis malorum* Berk.) of the apple, pear, and quince is of comparatively slight economic importance in New Zealand. The fungus, the stages in the life-history of which are described and figured, causes cankers on the branches, spots on the leaves, and a decay of the fruits. The cankers, which first appear as small, elliptical areas, show numerous crevices, arranged in zones. They may continue to grow for several seasons, or until the branch is girdled, when the portions above the canker die. A yellow discoloration of the foliage frequently precedes death. The hyphae of the fungus are found in the discoloured sap-wood beneath the canker, and the fructifications subsequently appear on the surface.

The spots on the leaves are minute, circular, scattered, and dark purple in colour. As they increase in size the central portion, which later changes to greyish-brown, may become surrounded by darker zones, this phenomenon having suggested the alternative name of the disease, 'frog-eye'.

Infected fruit is covered by small, circular, brown areas which rapidly extend, finally causing complete decay. The fruit remains firm and spongy until it eventually turns jet-black and shrivels up.

On the branches and fruits the fungus behaves as a wound parasite, entry apparently being effected only through some abrasion in the bark or epidermis; on leaves it behaves as a true parasite, infecting them directly through the epidermis.

P. cydoniae overwinters by means of resting mycelium in cankers, mummified fruits, and probably fallen leaves, and the control of the disease is best ensured by the removal of these sources of infection.

ANTHONY (R. D.) & WARING (J. H.). **The Apple industry of Pennsylvania.**—*Pennsylvania Dept. Agric. Gen. Bull.* 369, 205 pp., 26 figs., 18 diag., 1923.

This valuable compilation, dealing, *inter alia*, with the history, extent, and commercial importance of the Pennsylvania apple industry, includes (pp. 132–134) a section on fungous diseases, the most serious of which are stated to be scab [*Venturia inaequalis*], frog-eye [*Physalospora cydoniae*], apple blotch [*Phyllosticta solitaria*], and fireblight [*Bacillus amylovorus*].

Scab causes very heavy losses in unsprayed orchards under suitable weather conditions. The most effective control measure appears to be three to five applications of lime-sulphur (1 in 40), combined with lead arsenate, beginning when the blossoms are pink.

Frog-eye and apple blotch are more especially diseases of the southern and south-eastern counties, the latter, however, gradually extending northwards. Frog-eye may be controlled by three summer sprays of lime-sulphur, but apple blotch, which is very severe on the Smith Cider variety, requires a later application of Bordeaux mixture.

Fireblight is extremely severe in Pennsylvania on young trees of the Grimes Golden Variety, and the excision of the cankers is stated to be the only cure. The growing of pears has been largely discontinued owing to the prevalence of this disease.

Crown gall [*Bacterium tumefaciens*], the importance of which is not generally recognized, is very common in Adams and Franklin counties. The normal growth of the trees is arrested and their yield decreased, while in many cases death occurs just when they would ordinarily be reaching their prime. It is essential that imported nursery stock should be submitted to expert inspection before planting.

Cedar rust [*Gymnosporangium juniperi-virginianae*] has caused much loss in the southern counties, but a campaign is now proceeding for the eradication of cedars [*Juniperus*] from all places where the cultivation of apples is of commercial importance.

Sooty blotch [*Phyllachora pomigena*], *Phoma* spot [*P. pomi*], and Baldwin and Jonathan spot are prevalent, and occasionally severe, all over the State.

GARDNER (M. W.), GREENE (L.), & BAKER (C. E.). **Apple blotch.** —*Purdue Agric. Exper. Stat. Bull.* 267, 32 pp., 12 figs., 1923.

Apple blotch (*Phyllosticta solitaria*) [see this *Review*, iii, p. 76] is becoming increasingly prevalent in central and southern Indiana on the Oldenburg, Ben Davis, Northwestern, and other important varieties, a list of which is given. According to the records of the Federal Plant Disease Survey, the disease causes the heaviest losses in Oklahoma, Arkansas, Mississippi, Alabama, Georgia, North and South Carolina, Tennessee, and Kentucky, amounting in 1920 to 4,000,000 bushels, or between 5 and 10 per cent. of the crop. At a conservative estimate the losses from blotch in Indiana in such years as 1920 and 1922 may be placed at 150,000 bushels.

The symptoms of the disease and life-history of the fungus are

briefly described. On the fruit are formed shiny, black blotches, one-eighth to one inch in diameter, with irregularly lobed margins and often presenting a pattern of radiating outgrowths. The blotches, which may be slightly elevated or sunken, bear near the centre the minute, black pycnidia containing the spores of the fungus, which are disseminated by rain or dew.

On the branches the cankers appear as dark or purplish, irregular spots, the central portion of which soon dries and turns brown. Each canker usually increases in size for several seasons by means of raised marginal extensions, which produce pycnidia and then wither, becoming delimited by fissures. On young trees the branches may be girdled, but the cambium is seldom injured.

There are two distinct types of infection on the leaves, one consisting of white, pin-head spots in the intervenal portions, and the other of elliptical or elongated, depressed, tan-coloured lesions on the veins or petioles. The latter is the more destructive form.

It has been found that blotch cankers remain active for many years. In 1921 the fungus was shown to be alive in limb cankers probably nearly 14 years old. Most of the leaf and fruit infection is believed to be caused by spores from the cankers, which are particularly prevalent on suckers and water sprouts, occurring also on the wild crab-apple. About 90 per cent. of the cankers on Northwesterns were found to be located at leaf scars, as the result of the fungus reaching the twig from basal petiole lesions on the leaves.

From 1919 to 1922 tests designed to verify for Indiana conditions the more recent spraying recommendations were carried out in three different localities. Dormant sprays of lime-sulphur 1 in 3 or 1 in 8, dry lime-sulphur 25 lb. per 50 galls., and copper sulphate 2 lb. per 50 galls., proved quite ineffectual in the control of the disease. The results of comparative experiments with Bordeaux 4–6–50, sulphur dust, and Bordeaux dust applied 2, 4, and 6 weeks after petal-fall, were in favour of the first named. Subsequent tests confirmed the efficacy of Bordeaux, which gave equally good results at a strength of 2–4–50. Lime-sulphur was much less reliable, especially on Oldenburg, but it may be used on varieties, such as Ben Davis, which are liable to serious russeting from Bordeaux mixture. When petal-fall occurs late an application of Bordeaux almost immediately afterwards is advisable, especially on Oldenburg in southern Indiana. Thoroughness of application is essential, a pressure of 200 to 250 lb. being recommended. The excision of cankers and the removal of all dead material are necessary for complete control.

A bibliography of 18 titles is appended.

GARDNER (M. W.). **Origin and control of Apple blotch cankers.** —*Journ. Agric. Res.*, xxv, 10, pp. 403–418, 3 pl., 1923.

Further observations on leaf scar infection by *Phyllosticta solitaria* [see last abstract] indicate that a large proportion are due to mycelial invasion from basal petiole lesions such as are commonly found on badly attacked trees. The fungus grows down inside the petiole to a distance of 2 or 3 mm. and even farther, and in many cases crosses the abscission layer into the twig tissue before the leaf

falls. Cankers may also originate from terminal bud-scale infection, and cankers on large limbs around the base of a spur may develop from a canker on that spur. The age of the canker is in general but slightly less than that of the wood on which it is located. The causal fungus has been found alive in the margins of cankers on wood 7 and 8 years old, and in one case on wood 14 years old. On suckers, water sprouts, nursery stock, and seedlings the cankers occur both at and between the leaf scars.

In old orchards it was observed that some varieties, e.g. Northwestern and Oldenburg, are more subject than others to abundant canker formation, especially in the lower parts of the trees, and are thus very important as carriers of the disease. Individual trees of the same variety appear to exhibit a more or less constant degree of susceptibility or resistance to canker formation in consecutive years. In young orchards, cankers were found on the trunks and older limbs of a considerable percentage of the trees, especially of the Oldenburg variety. The infected trees were scattered, and there was evidence of the introduction of the disease with the nursery stock and very little evidence of tree-to-tree spread in young orchards. In nurseries, cankers were found in great abundance on both stock and scion and on seedlings used for budding. The evidence indicated that the nursery-row affords very favourable conditions for the spread of the disease.

The results of the experiments in the control of the disease [see last abstract] are described. Experiments also showed that in young orchards the eradication of blotch cankers is feasible by pruning cankered spurs and twigs and by excising the cankers on the larger limbs. The cankers are shallow and can be shaved off with a sharp knife in the early spring without injuring the underlying cambium. The cuts must be deep enough to remove all the discoloured tissue, and must extend about 1 cm. beyond the visible margin of the canker. Healing was rapid, and no disinfectant or wound dressing was found necessary.

The author believes that by canker eradication and by annual application of sprays to prevent the formation of new cankers, the disease can be effectively controlled in young orchards.

Reimer (F. C.). **Blight and other Pear problems.**—*Better Fruit*, xviii, 6, pp. 5-6, 2 figs., 1923.

A brief account is given of the breeding and selection work in progress at the Southern Oregon Experiment Station in connexion with the development of pear varieties resistant to blight [*Bacillus amylovorus*]. All cultivated American varieties, wild European, Asiatic, and African species, and cultivated varieties from Europe, China, and Japan, have been collected and inoculated with pear blight bacilli. Nearly all were found to be susceptible, but there is a small percentage of resistant types, which are now being propagated as rapidly as possible. Some of these immune pears—said to be the first recorded in America—appear extremely promising as blight-resistant stocks on which to topgraft the commercial varieties. Experiments are also in progress in crossing the best American varieties, e.g. Bosc and Anjou, with the best blight-immune Chinese species.

WOODROFF (J. G.). **The Pineapple Pear.**—*Georgia Agric. Exper. Stat. Bull.* 142, pp. 78–105, 8 figs., 1923. [Received 1924.]

The Pineapple pear (also known as the Chinese, Chinese sand, Japanese sand, hybrid sand, Florida sand, sand, Bull Nose, and banana pear) is a hybrid of *Pyrus communis* × *P. serotina*. It is almost entirely immune from blight (*Bacillus amylovorus*) and is believed to be descended from one of the extensive plantings of resistant varieties made about 1860. Apart from its resistance to blight, the Pineapple pear is stated to be an ideal tree for the coastal plain, including Florida, the eastern part of South Carolina, and the lower parts of Georgia, Alabama, Mississippi, and Louisiana. It is readily propagated, an early and prolific bearer, and extremely vigorous. The fruit is of mediocre quality, more promising for canning than for dessert purposes. The tree is now being tested in Virginia, Michigan, Oregon, Ontario, and elsewhere. It is susceptible to leaf spot [*Fabraea maculata*].

The results of ten years' experiments on the blight resistance of a number of well-known pear varieties have shown hybrids (including Kieffer, Le Conte, Garber, Golden Russet, and Pineapple) as a whole to be more resistant than common pears. The last-named showed no signs of blight up to the time of collecting the data in 1922.

Grafts of the Pineapple pear were made on common stocks, the latter succumbing to blight, while the scions remained healthy. When the process was reversed the common scions blighted, leaving the Pineapple stocks healthy. There seems to be no transmission of resistance from stock to scion.

The early blooming of the Pineapple reduces the chances of infection through the flowers, as there are few, if any, other pear blossoms open at the time from which the causal organism might be spread by visiting insects.

In March 1916 ten clusters of Pineapple pear were sprayed with a pure culture of *B. amylovorus*. Eight showed signs of infection and the youngest growth was killed. In no case, however, did infection pass back into the mature wood of the previous season's growth.

A bibliography of 21 titles is appended.

BROOKS (F. T.) & MOORE (W. C.). **On the invasion of woody tissues by wound parasites.**—*Proc. Cambridge Phil. Soc. (Biol. Sci.)*, i, 1, pp. 56–58, 1 fig., 1923.

Investigations have recently been carried out by the authors on the initiation of invasion by the silver leaf fungus (*Stereum purpureum*). In the first experiment, three-year-old shoots of Victoria plum trees, about eight inches long, were placed in water in the laboratory and an emulsion of *S. purpureum* spores in sterile water applied to their freshly cut upper extremities. The shoots were then left exposed to the air, longitudinal sections being cut through the inoculated ends of the twigs at intervals of two, four, and six days after the application of the spores. Sections cut after two days showed that most of the spores had been absorbed into the vessels, some to a distance of 3 mm., where they were beginning to germinate. The few spores left on the surface of the wood were

not germinating and none had been sucked into the other cells of the wood, pith, or bark. The spores of *S. purpureum* are extremely minute, their longest axis being only about one-sixth of the diameter of plum wood vessels. After four and six days the sections revealed a vigorous mycelium rapidly passing down into the wood through the vessels.

In the next test, sections were cut almost immediately after the application of the spore emulsion to the extremities of the branches, and it was shown that the spores had already been absorbed into the vessels, to a maximum distance of 6 mm.

Indian ink similarly applied to the freshly cut extremities of plum shoots was also immediately absorbed, frequently being carried further downwards than the spores. The absorption of the latter, therefore, is a purely passive process.

Spores applied to the wood in a dry state were not taken into the vessels except occasionally to a distance of 0·1 mm. and there was very little germination. Spores were also brought into contact with surfaces cut one or several days previously, always with the result (when an emulsion was used) that they were taken a considerable distance into the vessels, though not usually so far as with newly exposed tissues.

Similar results were obtained when the spores were applied in the same way to wounded fruit trees in the open, and it is, therefore, safe to assume that in the autumn and winter the absorption of the spores of *S. purpureum* into the vessels before germination is of general occurrence.

In a freshly cut branch, exposure to the atmosphere probably causes a depression of the water level in the vessels, resulting in the immediate absorption of the spore emulsion by these capillaries. Subsequent desiccation at the surface may increase the distance to which the spores are taken in the vessels. On the other hand, in wood which had been allowed to dry before the application of the emulsion, the ends of the capillaries would at once absorb the spores with the fluid.

It is pointed out that the spores of *Polyporus squamosus*, *Collybia velutipes*, and other wound parasites which infect through the wood rather than the bark, are uniformly minute enough to admit of absorption into the vessels in the manner described.

Ferdinandsen (C.). **Sølvglans. En af Purpur-Barksvamp (Stereum purpureum) Fr. fremkaldt Sygdom.** [Silver leaf. A disease produced by the purple bark fungus (*Stereum purpureum* Fr.).]—*Medd. Foren. til Svampekundsk. Fremme*, pp. 22–32, 2 figs., 1923.

The history, distribution, symptoms, and control of silver leaf (*Stereum purpureum*) are described, with special reference to the work of Percival, Brooks, and Güssow, a *résumé* of which is given.

The first record of the disease in Denmark dates from 1900, when it was observed on damson trees imported from France and subsequently on two-year-old plum trees on which grafts had been made with damson scions. Since that date there have been isolated cases of infection reported from different parts of the country—

always on the Victoria variety—and though there is no immediate cause for alarm the author thinks that every effort should be made to eradicate the fungus from Danish orchards.

PARKER (C. S.). **Coryneum blight of stone fruits in Washington.**—Abs. in *Phytopath.*, xiii, 11, p. 510, 1923.

Artificial inoculation and re-isolation experiments with the organism discussed in this note, on peaches, apricots, and cherries, resulted in the production of the typical symptoms of *Coryneum* blight, which periodically assumes some economic importance in parts of Washington. The organism was identified as *Coryneum beijerinckii.* Infection took place only through the stomata or ruptured epidermal leaf tissue. The fruiting body was shown to be an acervulus, readily reproducible on the twigs of host plants but never on dextrose or prune agar. Spores on the natural matrix resist unfavourable conditions for a very lengthy period, germinating within 24 hours after 19 days of desiccation.

DODGE (B. O.). **Systemic infections of Rubus with the orange rusts.**—*Journ. Agric. Res.*, xxv, 5, pp. 209–242, 7 pl., 7 figs., 1923.

Investigations were carried out during 1921–22 in North Carolina, Virginia, and elsewhere, on the distribution of the gametophytic mycelium of the short-cycled orange rust ('*Kunkelia nitens*') in the blackberry (*Rubus* spp.) and dewberry (*Rubus hispidus*), and of the mycelium of the long-cycled rust (*Gymnoconia interstitialis*) in the blackberry, dewberry, and black raspberry (*R. occidentalis*). In the case of perennial parasitism of blackberry canes by either rust, hyphae are mostly confined to the central pith and fundamental tissues of the growing regions. At the nodes traces of mycelium are sometimes found along the rays in the wood and in the cambium and phloem. The roots are extensively penetrated, the hyphae following the cambium and sieve-tubes of the runners for many feet. New plants arising from invaded root runners are infected, and in nature the dissemination of the rust is frequently effected through the connecting roots. The cortex is also attacked, but there is very little mycelium in the woody tissue. In the dewberry the roots are not penetrated to such an extent as in the blackberry, but the methods of dissemination of the rust are similar in both hosts. The method of infection of *R. occidentalis* is similar to that of *R. hispidus*, but the rust is not so often disseminated vegetatively to tip plants from an infected parent as in the case of blackberry and dewberry, since the canes of infected black raspberries do not readily root at the tips. Dissemination in this host is largely effected by means of sporidia from teleutospores. Artificial infection of *R. occidentalis* and the cultivated Plum Farmer and Cumberland varieties of this plant was secured by laying black raspberry or blackberry leaves bearing teleutospores over rooting tips of stolons, and maintaining suitable moisture conditions.

It was found possible to make 150 separate primary infections on susceptible varieties of cultivated blackberry, by sowing on young root shoots the sporidia of the short-cycled rust. The

hyphae in most cases were confined to the cambium and phloem tissues, and infected canes generally blossomed normally except at the infected nodes. On the other hand, canes arising from an infected hill and having mycelium in the growing parts from the beginning do not blossom.

The sporophytic stage of the *Gymnoconia* was further found to be transmissible in nature from the mountain blackberry (*R. canadensis*) to cultivated varieties of blackberry and to loganberries [a supposed blackberry-raspberry hybrid]. Teleutospores were obtained on the leaves of susceptible blackberries and dewberries by sowing aecidiospores from the black raspberry and vice versa. The Lawton blackberry appears to be immune from, and the Snyder very resistant to, orange rust. In North Carolina the Lucretia dewberry approaches complete immunity. The southern dewberry (*R. enslenii*), which is susceptible to the short-cycled rust, was readily infected by sowing aecidiospores of the long-cycled *Gymnoconia* from *R. occidentalis* on the leaves.

Considerable differences in the reactions of various hosts to infection by the two rusts are believed to exist. Thus the Iceberg variety of blackberry, which is very susceptible to the short-cycled form from blackberry, is highly resistant to the long-cycled form from the wild dewberry. There is, however, no reason to assume the existence of distinct biological strains within these two rusts, except that some may display more vigorous parasitism than others.

A thorough inspection of nursery stock for at least a month after planting, and the complete eradication of rusted plants, are suggested as valuable control measures.

CROWLEY (D. J.). **Preliminary report on rots of the Cranberry in Pacific County.**—Abs. in *Phytopath.*, xiii, 11, pp. 509–510, 1923.

The following organisms were found to be implicated in storage rots of cranberries [*Vaccinium macrocarpon*] grown in the bogs of Pacific County, Washington: *Fusicoccum putrefaciens*; *Guignardia vaccinii*; *Pestalozzia guepini vaccinii*; *Fusarium oxycocci*; *Sporonema pulvinatum*; *Anthostomella destruens*; *Phomopsis* sp.; *Stemphylium* sp.; and *Botrytis* sp. The storage of the berries at 32° F. reduced the losses by about one-half.

TURNER (A. D.). **'Red plant' disease of Strawberries.**—*The Fruit Grower*, lv, pp. 971–972, 1 fig., 1923.

A number of plants affected by the trouble known as 'red plant' have been under observation by the writer in Somerset [England] since 1920. During the first year the plants were practically normal, but in the second season they remained stunted, with small, thin leaves, wiry petioles, and an absence of hairs on the young growths. A few malformed flowers appeared, which failed to set fruit, and the plants immediately began to form runners freely. In 1923 the typical red coloration became noticeable, the leaves being curled or rolled and the whole plant below the normal size and late in starting growth. The disease has hitherto only been observed in the Royal Sovereign variety, but may possibly

be present in other varieties without the characteristic red coloration.

In many respects 'red plant' resembles the mosaic and leaf roll diseases of potatoes and 'reversion' in black currants. The trouble appears to be constitutional and transmissible from an affected plant to its progeny. Runners of three different origins planted in the same place showed in one case only 0·5 per cent. diseased in 4 years and in the other two 3·75 and 24 per cent., respectively, in 3 years. Hence a careful selection of runners for planting is recommended.

JØRSTAD (I.). **Beretning om sprøiteforsøk mot soppsykdommer i frukthaven i 1922.** [Report on spraying experiments against fungous diseases in the orchard in 1922.]—*Christiania, Grøndahl & Søns Boktrykkeri*, 21 pp., 1923.

During 1922 an extensive series of spraying experiments was carried out both in the east and west of Norway. Owing to the damp and cold weather, however, the fruit crop in the latter district was a failure, and no definite conclusions as to the respective merits of the various fungicides could be reached there.

Apple scab [*Venturia inaequalis*] on Torsteins was well controlled by four applications of lime-sulphur on 2nd and 22nd June and 5th and 29th July, nicotine sulphate being added to the first spray. The omission of the third or fourth application did not perceptibly reduce the value of the treatment, whereas that of the second, both second and third, or both third and fourth noticeably decreased its efficacy. The percentage of infection in the group which received all four applications was 16·5, as compared with 28·2 in that receiving only the first two sprays, and 67·5 in that given only the first and fourth. A group which received only nicotine and arsenate showed 46·9 per cent. infected, while the untreated controls had 97·9 per cent.

In another test, on Gravensteins, four applications of lime-sulphur were given on 1st and 24th June and 12th and 27th July, nicotine sulphate being added to the first spray. The omission of the final spray was immaterial, whereas that of the second reduced the efficacy of the treatment.

Gravensteins in another orchard gave the best results when sprayed on 15th May and 8th June with lime-sulphur and lead arsenate, and on 4th August with lime-sulphur alone. Details of further experiments on the same lines are given.

Apple mildew [*Podosphaera leucotricha*] was best controlled by two applications (on 1st June and 17th July) of lime-sulphur plus gelatine (75 gm. per 100 l.), and by dusting with lime-sulphur and calcium arsenate. Formalin and lime-sulphur without a spreader were not satisfactory. Nicotine soap was moderately efficacious, but somewhat affected the leaves.

The control of *Monilia* [*Sclerotinia*] on Früheste der Mark and Heart Morello cherries was well effected by spraying on 4th April with lime-sulphur at winter strength and on 16th May with lime-sulphur at summer strength, plus nicotine sulphate. The improvement was more noticeable in the Früheste der Mark variety.

Brierley (W. G.). **What it costs to spray.**—*Minnesota Horticulturist*, li, 5, pp. 129–131, 1923.

The results of a survey of the cost of apple production in Minnesota, based on the figures for 1914 to 1920 inclusive, show that the total cost, including labour, depreciation, &c., of spraying one acre of apples with 125 galls. of a lead arsenate and lime-sulphur mixture is $6·37 per annum. It was also found that power spraying was cheaper, more effective, and much quicker than the barrel method, the total cost per acre by the former being $6·278 as compared with $6·547 by the latter. The use of spray guns in preference to rods is also to be recommended, the former covering 5·23 acres and the latter only 1·86 acres per diem.

Forsøg med Afsvampning af Vintersæd. [Experiments in the disinfection of winter seed.]—*Statens Forsøgsvirksomhed i Plantekultur Medd.*, 103, 4 pp., 1923.

The following is a brief preliminary account of the most recent results obtained at the Danish State Phytopathological Experiment Station from comparative tests of various well-known disinfectants for the control of bunt of wheat (*Tilletia* '*caries*') [*T. tritici* and *T. levis*] and flag smut of rye (*Urocystis occulta*).

Bunt of wheat was satisfactorily controlled by sprinkling with one per cent. copper sulphate, germination, however, being notably impaired, besides which only moderately protection against reinfection was afforded. Immersion in 0·5 per cent. copper sulphate solution for ten minutes gave uniformly better results than sprinkling, except as regards reinfection from contact with old sacks and the like.

Formalin (sprinkling and immersion) gave satisfactory results as regards germination in laboratory experiments, but it is now well established that a serious reduction occurs, when sowing is delayed after this treatment, in the percentage of plants germinating in the field. Further attempts are in progress to counteract this disadvantage by rinsing the treated seed in water, as the formalin treatment is the most economical of all those tested against bunt. The disease was well controlled by formalin, but there was no protection against reinfection.

Uspulun (0·25 or 0·5 per cent., immersion for two hours) is apt to retard germination, but frequently increases the percentage of germinating seed, this being particularly noticeable in the field. Much better results have been obtained in the control of bunt since the manufacturers increased the strength of the solution, and also by the substitution of immersion for sprinkling. The protection against reinfection was generally greater than that afforded by copper sulphate.

Germisan (0·25 per cent., immersion for 30 minutes or 2 hours, or sprinkling with 0·5 per cent.) almost invariably retarded germination to a considerable extent. This delay, however, was frequently counterbalanced by the good progress of the plants subsequently. Protection against reinfection with bunt was uncertain.

Tillantin B (sprinkling with 0·5 per cent. or immersion for one or two hours in 0·2 per cent.) gave very good results in the few

tests in which it was used. In cases of severe infection with bunt, however, the prescribed strength seems scarcely adequate.

Fusariol (sprinkling with 0·4 per cent.) was only once tested against bunt with excellent results both as regards germination and disinfection. The preparation is comparatively cheap.

Dusting with copper carbonate (200 to 250 gm. per hectogm. of seed grain in a rotatory apparatus for 5 to 10 minutes) gave very satisfactory results against bunt. The risk of reinfection was greatly modified by this method.

Flag smut of rye was satisfactorily controlled by sprinkling with copper sulphate 1 per cent., formalin 0·25 per cent., and uspulun 0·6 per cent., but germination was usually very slightly retarded. Germisan and fusariol also slightly delayed germination, which was, however, promoted by dusting with copper carbonate. The effect of these last three treatments on the incidence of flag smut could not be ascertained owing to its almost complete absence during the period in which these particular fungicides were tested.

GABEL (W.). **Beitrag zur Zusammensetzung von Saatgutbeizen.** [Contribution to the composition of seed disinfectants.]—*Zeitschr. für angew. Chemie.* xxxvi, 75, p. 590, 1923.

Kalimat [see this *Review*, ii, p. 416] is a colourless liquid, with the specific gravity (15° C.) 1·1334, consisting mainly of a solution of phenol and formaldehyde. The determination of formaldehyde, by weight of that substance, gave 22·6 and 22·7 per cent. respectively in two tests, while 30 c.c. of phenol were obtained, by methods which are described, from 100 gm. kalimat. The effect of the preparation is due to the combined presence of phenol and formaldehyde. There is no chemical union of these two substances, but a mixture or a solution of carbolic acid in formalin.

Fungolit (Charcoal Industry, Constance) is a reddish-brown powder with an acid reaction, soluble in water, in which it leaves a residue of diatomaceous earth. The powder exhales a strong odour of hydrochloric acid. The red coloration is attributable to the presence of ferric thiocyanate, which can be shaken out with ether. On analysis it was found to contain 17·8 per cent. ferric thiocyanate, 29·5 per cent. ferric chloride, 7·7 per cent. mercury, and 27 per cent. diatomaceous earth saturated with hydrochloric acid. Potassium was present in the form of chloride. Fluorine could not be detected. The efficacy of the preparation is due to the presence of mercury salts, presumably chloride.

HAGEMANN (G. A.). **Afsvampning af Saasæd.** [Disinfection of seed.]—*Ugeskr. for Landmaend*, lxviii, 48, pp. 694–695, 1923.

The writer protests against the increasing use of new and expensive patent methods of seed disinfection (germisan, uspulun, &c.) when equally good results can be secured by immersion in a 1 per cent. solution of corrosive sublimate. With the possible exception of the dry copper carbonate dust, which is unsurpassed for convenience and efficiency, the expense of the new preparations is stated to be out of all proportion to their value.

BUTLER (O.). **Chemical, physical, and biological properties of Bordeaux mixtures.**—*Indus. & Engin. Chem.*, xv, 10, pp. 1039–1041, 1923.

Millardet's original formula for Bordeaux mixture (1885) consisted of copper sulphate 5·71 parts, quicklime 10·71 parts, and water to make 100 parts. Various modifications of this formula were subsequently introduced, and before the close of the 19th century three types of Bordeaux mixture were recognized in literature—the acid, neutral, and alkaline solutions.

Acid Bordeaux mixture is usually made by adding milk of lime to a solution of cupric sulphate until an alkaline reaction is obtained, when a small amount of cupric sulphate is added (0·1 per cent. for a 1 per cent. mixture and 0·2 per cent. for a 2 per cent. mixture).

Neutral Bordeaux is prepared by adding milk of lime to a solution of cupric sulphate until no soluble copper can be detected by means of potassium ferrocyanide, or by adding milk of lime up to the point where an alkaline reaction is just given. A mixture in which the ratio of cupric sulphate to quicklime is 1 : 0·3 falls into this group.

Alkaline Bordeaux is a wash containing cupric sulphate to quicklime in a ratio of 1 : 0·5 or more, mixtures containing as much as 1 : 3 and 1 : 5 having recently been introduced. The alkaline mixture most commonly used in the United States consists of cupric sulphate and quicklime in equal amounts.

The ratio cupric sulphate to quicklime used in preparing a Bordeaux mixture has an important effect on the chemical, physical, and biological properties of the wash.

According to Pickering (*Journ. Chem. Soc.*, xci, p. 307, 1907) the following distinct basic salts may be formed when cupric sulphate is precipitated by calcium hydrate in the form of lime water: $4CuO.SO_3$, $5CuO.SO_3$, $10CuO.SO_3$, $10CuO.SO_3.3CaO$, and $CuO.3CaO$, the last being of little interest to the plant pathologist. These basic sulphates are formed when cupric sulphate and calcium hydrate are combined in the proper proportions to give the following ratios of cupric sulphate to calcium oxide: $4CuO.SO_3$, 1 : 0·166; $5CuO.SO_3$, 1 : 0·181; $10CuO.SO_3$, 1 : 0·2; $10CuO.SO_3.3CaO$, 1 : 0·269. The basic sulphates $4CuO.SO_3$ and $5CuO.SO_3$ are somewhat soluble in the mother liquor, the former to the extent of 1 part in 40,000, the latter to that of 1 to 2 parts per million. The other basic salts are quite insoluble in the mother liquor, though they dissolve, beginning with $10CuO.SO_3$, with increasing readiness in saccharose.

When the basic sulphates are boiled, $10CuO.SO_3$ decomposes with formation of cupric oxide, the other basic salts remaining unaffected.

In practice the only basic sulphates found in Bordeaux mixture are $5CuO.SO_3$, $10CuO.SO_3$, and $10CuO.SO_3.3CaO$, the latter either alone or mixed (according to Pickering) with a more highly basic salt, the composition of which has not been determined.

In acid and neutral Bordeaux mixtures cupric oxide gradually forms on standing, not appearing, however, in mixtures in which the ratio of cupric sulphate to calcium oxide lies between 1 : 0·25

and 1 : 1. When, however, mixtures of these latter types are boiled cupric oxide may or may not form, according to the percentage strength of cupric sulphate in the mixture. As soon as there is sufficient calcium hydrate in solution to give, on combining with the cupric sulphate, the basic sulphate $10CuO.SO_3.3CaO$ or $10CuO.SO_3.3CaO$ admixed with higher basic salts, no cupric oxide forms on boiling the mixture.

When first prepared Bordeaux mixtures form unstable, gelatinous precipitates which change according to temperature, percentage strength in cupric sulphate, and the ratio of the latter to calcium oxide. In acid and neutral Bordeaux mixtures the precipitate becomes granular with age, whereas in alkaline washes it is usually replaced by spherocrystals, the copper salt being then in the form of blue crystals which undergo no further change in the mother liquor. In a series of Bordeaux mixtures containing 0·125, 0·50, 1, 2, 4, and 6 per cent. cupric sulphate, in which the ratio of the latter to calcium oxide is 1 : 1, spherocrystals will appear in all except the first. Mixtures in which the ratio of cupric sulphate to calcium oxide is 1 : 0·5 behave similarly to 1 : 1 mixtures: the 0·125 per cent. mixture shows little or no change with age, while in the stronger mixtures blue spherocrystals appear, but more slowly than in washes of the 1 : 1 type.

The crystallization of Bordeaux mixtures, which destroys their adhesive properties and leads to rapid settling, may be prevented by the use of a small quantity of saccharose (2 oz. per 50 galls. of a 1 per cent. mixture 1 : 1).

Acid Bordeaux mixtures are less adhesive than neutral washes, and very alkaline solutions do not adhere as well as those in which the ratio of cupric sulphate to quicklime is 1 : 0·5. Strictly neutral Bordeaux mixtures have not been found serviceable in practice, since, when they dry on foliage, the ratio of drying of the surface exposed to the air is so much more rapid than that of the surface in contact with the leaf that the resulting tension causes the edges of the leaves to curl and the greater part of the mixture flakes off. What is necessary is copper in a very fine state of division. Mixtures in which the copper precipitate has assumed the crystalline form are much less adhesive than freshly made washes.

Dealing with the biological properties of the different types of Bordeaux mixture, the author gives a brief résumé of his recently published work [see this *Review*, ii, p. 507].

As regards the action of Bordeaux mixtures on sprayed plants, it is necessary to study both the effect of the spray at the time of application and after it has dried. The latter effect appears to depend entirely on the degree of sensitivity of the plant to soluble copper. The action of the mixtures at the time of application depends, on the other hand, on the type of mixture used, the kind and variety of plant sprayed, and the nature and age of the sprayed organs. In the grape, alkaline washes are more injurious than neutral mixtures, the young leaves being principally affected. In the peach, alkaline washes are more injurious to young than to old leaves, the reverse being the case with neutral mixtures. Unlike the grape, however, the peach is sensitive to soluble copper, and eventually the differences in behaviour of the foliage im-

mediately following spraying are masked by copper injury. In the tomato, alkaline washes are more injurious than neutral ones, especially on young leaves. In the apple, neutral and alkaline Bordeaux mixtures of the usual type are injurious, the degree of alkalinity not apparently influencing the intensity of the injury caused. Apple fruit is very much more sensitive than the foliage to soluble copper, but the type of mixture introduced by Sanders and Brittain, in which the ratio of cupric sulphate to calcium oxide is 1 : 3 and 1 : 5, may safely be used. The reduction in the amount of injury is effected, not by any change in the nature of the copper precipitate formed, but by the fact that the large excess of lime delays and impedes carbonation and consequently the dissolution of the copper in meteoric water.

HOOKER (H. D.). **Colloidal copper hydroxide as a fungicide.**—*Indus. and Engin. Chem.*, xv, 11, pp. 1177–1178, 1923.

Colloidal copper hydroxide was prepared by a modification of Bradfield's method (*Journ. Amer. Chem. Soc.*, xliv, p. 965, 1922) for the preparation of colloidal iron hydroxide, aluminium hydroxide, and silicic acid. A 10 per cent. solution of sodium hydroxide was added to a solution of copper sulphate with constant stirring until the supernatant liquid lost its colour. Copper hydroxide was thrown down as a pale blue precipitate. The formation of a deep blue precipitate, which changes on standing to a black copper oxide, is due to an excess of alkali, which must be avoided.

When first thrown down by the addition of sodium hydroxide solution the mixture obtained was far from homogeneous. It was pumped under pressure through a spray nozzle after every few washings, transferred to a glass vessel, and allowed to settle for 24 hours. The supernatant liquid was siphoned off, distilled water was added, and the whole mixed by stirring. After a dozen such washings practically all the free salt was removed. When the precipitate finally settled, an opalescent, supernatant liquid was left, containing a very small amount of copper hydroxide, which settled out after standing for a few days. The maximum concentration and dispersion obtained by the process described was 1 part by weight of copper hydroxide in 1,000 of water. The material thus prepared is a delicate, robin's egg blue by reflected, and blue-green by transmitted, light. A true colloidal solution can be obtained by centrifuging several times.

In order to test the efficacy of this preparation as a fungicide, spraying experiments were carried out in the control of scab [*Venturia inaequalis*] and blotch [*Phyllosticta solitaria*] on Ben Davis apples. Two distinct types of copper hydroxide were used: one was a sediment (in four dilutions) from which all free soluble salts had been washed, and the other an incipiently colloidal preparation (in three dilutions) purified by the sedimentation method described above. Three sprays were given, namely, a calyx application on 11th May, followed by sprays on 21st May and 4th June [1923], lead arsenate being added to the two latter at the rate of 3 lb. per 100 galls. Fifteen trees in the same orchard were simultaneously sprayed with 3–4–50 Bordeaux and fifteen others with 3 in 100 lime-sulphur, while a large number were left untreated.

The early part of the season was characterized by cool, wet weather. After the final spray application it was found that the first dilution of the colloid (0·076 per cent.) had produced exceptionally severe burning; the second (0·038 per cent.) gave burning approximately equal to the 3–4–50 Bordeaux; while the lowest dilution (0·019) caused very little injury. The first dilution of the sediment (0·4 per cent.) also produced severe burning, though somewhat less so than the colloid; the second (0·2 per cent.) was about equal to 3–4–50 Bordeaux; and the third and fourth (0.1 and 0·05 per cent.) slightly less. It was noteworthy that dilution of the colloidal preparation reduced burning to a greater extent than did similar dilution of the sediment.

The unsprayed fruit showed both scab and blotch in approximate proportions of 13 and 7 per cent. respectively, while not a trace of either disease was found on any of the apples from the trees treated with copper hydroxide. The severe burning caused by the first dilutions of the sediment and colloid, however, resulted in the loss of all the fruits on the trees thus treated.

It is important to note that complete protection from both diseases was ensured by the weakest concentration of the colloidal copper hydroxide, the burning caused by which was negligible. The amount of copper used was one-fifteenth of that required in 3–4–50 Bordeaux. Should the results of these preliminary tests be confirmed they would indicate that 1 lb. of copper as colloidal copper hydroxide would suffice to spray two to three acres of orchard once. It is also possible that an even more dilute concentration may give adequate protection and no burning. It is clear even from these few data that the use of colloidal copper hydroxide would result in a considerable saving in the cost of fungicidal materials.

A few additional tests showed that the preparation (at a strength of 1 in 5,000) can be mixed with nicotine sulphate and sprayed on peach and cherry trees without causing any burning injury.

PAILLOT (A.). **Nouvelle formule de bouillie mixte pour le traitement d'hiver des arbres fruitiers.** [New formula for a combined mixture for the winter treatment of fruit trees.]—*Comptes Rendus Acad. d'Agriculture de France*, ix, 31, pp. 809-812, 1923.

During the winter of 1922–23 the following formula was devised and tested at the South-Eastern Entomological Station (Vienne) for the combined control of insect and fungous diseases of pear, apple, and other fruit trees: copper sulphate 2 kg.; hydrated lime 3 kg.; anthracene oil 10 l.; casein 50 gm.; water 90 l. The casein may be replaced by 250 c.c. of sulforicinate of soda. Directions are given for the preparation of the mixture, which has successfully controlled, besides various insect pests, leaf curl [*Exoascus deformans*] and *Coryneum* [*beijerinckii*] of the peach, and *Sphaeropsis pseudodiplodia* of the pear. The winter treatment should be concluded before March in order to avoid any risk of burning the buds.

SALMON (E. S.). **Sixth Report on the trial of new varieties of Hops.**—*Journ. Inst. of Brewing*, xxix, 11, pp. 879–915, 1923.

Of the 55 new varieties of hops undergoing trial at the East Malling Research Station (Kent), M 45 proved to be one of the most promising. It is immune from mosaic, and its periodical attacks of 'mould' [mildew: *Sphaerotheca humuli*] readily yield to suitable treatment.

When tested on a commercial scale on certain Kentish farms, however, the variety proved to be a 'carrier' of mosaic, that is, it is capable of infecting susceptible varieties while itself showing no symptoms of the disease. In one case a row of 48 hills of M 45 was planted towards the centre of a six-acre garden of Tutshams. Three years later the hop-garden showed a severe attack of typical mosaic disease in the part immediately adjoining the M 45 rows, the latter being unaffected. Several similar instances were recorded, and it is therefore recommended that the cultivation of M 45 in proximity to susceptible varieties be discontinued. Probably it may safely be grown in the vicinity of the Fuggles variety, which appears to be immune from mosaic.

It is of interest to note that in the severe mosaic epidemic of 1922, the incidence of the disease amounted to 31 per cent. in the commercial varieties usually grown and only 5·4 per cent. in the new varieties.

PIJPER (A.). **Bronchomoniliasis and Monilia-fungi in sputum.**—*Med. Journ. S. Africa*, xix, 4, pp. 101–111, 5 figs., 1923.

This paper deals with the relations between diseases of the respiratory organs, usually grouped under the heading 'bronchomoniliasis', and fungi of the genus *Monilia*. In over 50 per cent. of the sputa examined (originating from patients suspected of tuberculosis) the presence of various strains of *Monilia*, which are classified according to Castellani's fermentation method, was demonstrated. Inoculation experiments on rabbits resulted in emaciation and other abnormal conditions. A selective culture method and the biochemical reactions of 43 species (which were shown by complement fixation tests to be subdivisible into three serological groups) are described. It is suggested that *Monilia* is much more commonly present in cases of chronic cough than is generally recognized.

DA FONSECA (O.) & DE ARÊA LEAO (A. E.). **Sur la systématique des champignons produisant des chromoblastomycoses.** [The systematic position of fungi producing chromoblastomycoses.] —*Comptes Rendus Soc. de Biol.*, lxxxix, 27, pp. 762–763, 1923.

Comparative investigations have shown that the North American verrucose dermatitis, caused by *Phialophora verrucosa* Medlar (1915), must be distinguished from Brazilian verrucose dermatitis which is due to *Acrotheca pedrosoi* = *Hormodendrum pedrosoi* Brumpt (1921).

A fungus, which is stated definitely to be identical with that last named, was isolated from eight cases of chromoblastomycosis in Brazil. The characteristic method of sporulation was, however,

apparently not observed by Brumpt. The nodose conidiophores now described are stated to occur rarely on Sabouraud's medium, but are common on those of Dox and Czapek. As a rule, the conidiophores are non-septate; in some cases, however, the fertile terminal portion elongates and divides into several cells. This slight difference is not considered sufficient to justify the establishment of a fresh genus.

Pollacci (G.). **Miceti del corpo umano e degli animali. (Nota terza.) Due nuovi Ifomiceti parassiti.** [Mycetes of the human and animal body. (Third note.) Two new parasitic Hyphomycetes.]—*Riv. di Biol.*, v, 3, pp. 358–367, 3 figs., 1923.

The morphological and cultural characters of two new pathogenic Hyphomycetes are described. The first, *Acremoniella perinii* n. sp., was isolated from the sputum of a female patient suffering from slight pulmonary infiltrations. Inoculations into guinea-pigs gave fatal results.

The second fungus, *Haplographium de bellae-marengoi* Pollacci var. *equinum* n.v., was isolated from a tumour in the outer pyramidal body of a horse's hoof.

Boncquet (P. A.). **Discovery of curly leaf of Sugar Beets in the Argentine Republic.**—*Phytopath.*, xiii, 10, pp. 458–460, 1923.

Curly leaf of beets was observed near Buenos Aires towards the end of 1916. The diseased plants were characterized by black rings in the root, protuberances on the leaves, and dwarfing of the heart leaves. A few specimens of the leafhopper (*Euttetix tenella*) were captured and found to be similar in habitat and habits to those responsible for the transmission of the disease in California [see this *Review*, i, p. 229].

In the experimental plots, kept under observation for three months, the youngest leaves of the plant began to show watery, translucent veins as soon as the beets were fully covering the ground. Five days later more than 50 per cent. of the plants had developed the typical symptoms of the disease, while ten days later nearly all were infected and many killed. *Euttetix tenella* was abundant both on the beet plots and in the adjacent bean fields, and it is concluded that it acted as the agent of transmission.

Peyronel (B.). **Fructification de l'endophyte à arbuscules et à vésicules des mycorhizes endotrophes.** [Fructification of the arbuscular and vesicular endophyte of endotrophic mycorrhiza.]—*Bull. Soc. Myc. de France*, xxxix, 2, pp. 119–126, 1 fig., 1923.

In most endotrophic mycorrhiza the fungus forms haustorium-like arbuscles and spore-like vesicles. This type of endophyte is considered by the author to be allied to the Phycomycetes and to differ sharply from the endophyte of the orchids. But a fungus similar to the latter is almost always found as a secondary organism

in the mycorrhiza formed by the other, and this double association has led to a certain amount of confusion.

The endophyte of the orchidaceous type has been isolated and cultivated by the author from the roots of many plants, including cereals, potato, tobacco, and vine, and is regarded as a *Rhizoctonia* allied to those of orchid mycorrhiza. Inoculations on aseptically grown wheat seedlings have given a type of infection resembling that already known in the orchids.

Attempts to cultivate the endophyte with arbuscles and vesicles have, however, failed, but the fungus has been traced into the soil, where it evidently is capable of vigorous growth and the formation of numerous and often very large vesicles. In the debris of dead roots in the soil the vesicles are often found empty at the end of the autumn, and near them citron-shaped, hyaline spores, 17 to 24 by 9 to 15 μ, have been observed, which seemed to have come from the vesicles or are even occasionally found within the latter. More recently the author has found numerous vesicles filled with spores at all stages of maturity, and he is satisfied that they are sporangia. Certain characters of the endophyte resemble those of the genus *Endogone*, and further work will be necessary to decide whether its affinities are with this genus or with the true Phycomycetes, and also whether one or more species are involved.

Burgess (P. S.) & Pember (F. R.). **'Active' aluminum as a factor detrimental to crop production in many acid soils.**—*Rhode Island Agric. Exper. Stat. Bull.* 194, 40 pp., 1923.

Investigations have been conducted on the rôle of aluminium as a factor in the toxicity of acid soils [see this *Review*, iii, p. 32].

The results of a series of preliminary pot experiments on Crosby Egyptian beets and Yellow Globe onions showed that the growth-inhibiting action of certain soils could be partly overcome by large applications of either soluble phosphates or lime, and much more so by both together. The specific detrimental factor was not correlated with excessive hydrogen-ion concentration *per se*, for where large acid phosphate applications were given this was largely increased, while the immediate yields were greatly enhanced.

The results of a series of experiments in the application of varying combinations of acid phosphate and limestone to Cos lettuce, onions, and barley on very acid soils (P_H 4·5) appeared to justify the following conclusions. Lime alone, while greatly reducing the amounts of active aluminium in the soils, did not give the largest yields. Acid phosphate alone usually produced large initial crops irrespective of accompanying high acidity, generally without reducing the amount of active aluminium in the soil as much as the lime treatment. Combinations of lime and acid phosphate were better than either alone, and are recommended for the correction of soil acidity. Heavy applications of soluble phosphates (without lime) exerted a depressing initial effect upon aluminium solubility, which lasted, however, only about three months. Small quantities of the aluminium of certain acid soils were found to be readily extracted with water.

In the same soil type, a fairly close correlation was found to exist between the growth of sensitive crop plants (lettuce, barley, and onions), the amounts of active aluminium present in the soil, and the H-ion concentration of the soil.

Greenhouse and field observations both indicated that large amounts of decomposing organic matter (compost, manure, or green manure) are efficient in counteracting the deleterious effects of active aluminium upon such sensitive crops as lettuce, spinach, and beets.

As a result of further field studies, a tentative classification of the comparative resistance of various crops to soil acidity and active aluminium is given, a large number of commonly grown plants being grouped into three classes, according as they are sensitive, moderately resistant, or very resistant, the limits in P_H, specific acidity, lime requirement, and active aluminium in parts per million of soil being defined.

The results of analyses of the barley and lettuce plants used in these crop experiments showed that heavy lime applications greatly reduced the aluminium absorbed by the plant while slightly increasing the percentage of phosphorus.

The plants receiving large quantities of acid phosphate grew well, though containing about the same proportion of aluminium as the controls. They also contained, however, three to five times as much phosphorus as the latter, and it would appear, therefore, that acid phosphate renders soluble aluminium salts non-toxic largely by counteracting their detrimental effects within the plants after absorption. Thus an important function of soluble phosphates applied to acid soils may be the nullification of the effects of such toxic substances as dissolved aluminium, manganese, and ferrous iron.

The highest percentages of aluminium were found in the roots, considerable amounts in the leaves, a little in the stem, and none in the grain.

Plants grown in naturally neutral or slightly alkaline soils contained as high percentages of aluminium as those grown in acid soils, but had three to five times as much phosphorus. The function of these comparatively large quantities of absorbed phosphates as an antidote to aluminium is considered to be unmistakable.

A bibliography of 32 titles is appended.

Rippel (A.). **Ueber die durch Mangan verursachte Eisenchlorose bei grünen Pflanzen.** [Iron chlorosis of green plants caused by manganese.]—*Biochem. Zeitschr.*, cxl, 4–6, pp. 315–323, 1923.

The results of experiments carried out at the Agricultural and Bacteriological Institute of Göttingen University showed that manganese, in the form of soluble manganese salts in water cultures, is capable of producing chlorosis in oats. This abnormal condition is remediable by an abundant supply of iron. It was found that the percentage of iron in chlorotic and healthy plants was exactly equal, so that it is evidently not the assimilation of the iron, but its action in the plant tissues, which is hindered by manganese when the latter is present in undue proportions.

McDonald (Margaret B.). **The synthesis of 'bios' by yeast grown in a solution of purified nutrients.**—*Journ. Biol. Chem.*, lvi, 2, pp. 489–499, 1923.

By a series of experiments [particulars of which are given] with three varieties of yeast, *Saccharomyces cerevisiae*, *S. ellipsoideus*, and 'yeast XII', it was shown that there was an increased production of yeast cells in a sucrose-mineral salts medium to which alcohol extract or water extract of the above-named yeasts, or of commercial yeasts, wheat germ, malt, peptone, Liebig's extract, or autoclaved beefsteak were added. Extracts of yeasts grown in a distilled water solution of pure sugar and nutrient salts served to stimulate the growth of seedings in the same medium quite effectively.

These results must be interpreted as signifying that yeast synthesizes a substance, under the experimental conditions described, which stimulates the growth of the culture to which it is added. This substance is undoubtedly Wildiers' 'bios' [see this *Review*, ii, p. 284]. Small seedings of yeast cells in the new environment of a fresh inoculation in a synthetic medium grow very slowly, but they proliferate much more rapidly when the nutrient principle 'bios' is supplied. 'Bios' appears to be a substance which, while capable of synthesis by the yeast cell, is formed with some difficulty. It is not an indispensable nutrient principle for yeast, being synthesized during the slow proliferation of yeast cells in a medium of purified nutrients, and cannot, therefore, be logically classed as a vitamin. Yeast cells developing slowly in a 'bios'-free nutrient solution accumulate the substance, so that extracts made from them accelerate the growth of seedings by providing it in abundance from the start.

Harvey (R. B.). **Conditions for heat canker and sunscald in plants.**—*Minnesota Horticulturist*, li, 11, pp. 331–333, 1 graph, 1 fig., 1923.

In Minnesota the effects of excessive temperatures in plants produced by the absorption of sunlight are frequently seen in the scalding of various fruits, such as gooseberries, plums, tomatoes, and strawberries, and in the heat canker of flax [see this *Review*, ii, p. 313]. During the summer the length of the daily sunshine period frequently exceeds 15 hours.

By means of an apparatus which is briefly described, the author made a number of determinations of the temperatures reached in the parts of fruits and vegetables exposed to the sun. The results showed that the temperature of an apple on the exposed side may reach 22 degrees F. higher than that of the shady side and 32 degrees more than that of the surrounding air. Strawberries showed a temperature of 94° F. on the south and 82° on the north side, with an air temperature of 73·5°. Red currants showed 81° on the south and 73·5° on the north, with an air temperature of 73·5°.

The heat canker of flax is caused by excessively high temperatures of the stems at ground level. On very sunny days the temperature of the surface of the soil reached 126° F., the temperature of the flax stems at ground level being 123·8°. Such

temperatures are seldom reached when the soil is kept sufficiently moist.

In general, green parts of fruits are heated to a greater degree than red or white parts, and fruits lying on or near the ground are more severely injured than those some distance from the soil. Shading either by leaves of the same plant or by a nurse crop, increasing the soil moisture, and keeping fruits as far above the soil as possible, will decrease the injury from this cause.

NÄSLUND (C.) & DERNBY (K. G.). **Untersuchungen über einige physiologische Eigenschaften der Strahlenpilze.** [Investigations on certain physiological qualities of the Actinomycetes.]—*Biochem. Zeitschr.*, cxxxvii, 4–6, pp. 497–564, 1 diag., 1923.

Comparative cultures of a number of named and unnamed species of *Actinomyces*, *Streptothrix*, and allied organisms from human and plant material were grown on a wide range of media. On all these media the growth of all the strains investigated was satisfactory, no selective preference for a particular medium being shown by any of them.

The limits of hydrogen-ion concentration for growth were P_H 5 on the acid side and P_H 9 on the alkaline, the optimum being between P_H 7 and 8. On bouillon without sugar all the cultures caused an increase in alkalinity of the medium, the P_H of which generally rose from 7 to 8. In 1 per cent. glucose bouillon, on the other hand, there was a marked increase in acidity (in one case P_H 7 to P_H 5·6 in 8 days), followed by a decline to the original value or, in long-continued cultures, to marked alkalinity (P_H 8). No constant differences in the behaviour of the different species in these respects were noticed.

Most of the strains showed vigorous proteolytic activity. Extracellular proteolytic enzymes were detected in several. Intracellular enzymes and also fairly active desamidases were also produced. Tryptic enzymes were the chief proteases formed. The limits of hydrogen-ion concentration for the activity of these approximately correspond to those for the growth of the organisms.

DANA (B. F.). **Notes on Rhizoctonia.**—Abs. in *Phytopath.*, xii, 11, p. 509, 1923.

The results of experimental work on potatoes at Pullman (Washington) showed that the largest quantity of table stock was secured by the selection of visibly clean seed stock, the number of clean tubers in the table stock being increased by treatment with mercuric chloride for the control of *Rhizoctonia* [*solani*].

In one test infected untreated seed gave 9 per cent., infected treated 59·5 per cent., and clean treated seed 80 per cent. clean table stock. Mercuric chloride was superior to formaldehyde in the control of *Rhizoctonia*. In a test which may be taken as representative, treatment with formaldehyde and mercuric chloride increased the yield of clean table stock from 50 per cent. in the untreated controls to 73 and 84 per cent. respectively. No increase of total yield resulted from the treatment with mercuric chloride (4 oz. per 30 galls. water for two hours just before planting). Cur-

tailing the time gave lessened control, even at double strength of the mercuric chloride solution.

There was no consistent increase in the yield or percentage of clean tubers as a result of spraying with Bordeaux mixture or soil fertilizer treatments. Late spring plantings gave a higher yield of clean tubers in the crop from infected seed than early spring planting under the same conditions.

Blodgett (F. M.). **Time-temperature curves for killing Potato tubers by heat treatment.**—*Phytopath.*, xiii, 11, pp. 465–475, 3 diag., 1923.

The experiments reported in this paper were carried out to test the efficacy of the hot-water and hot-oven treatments in the disinfection of potato tubers affected by leaf roll and mosaic. At the same time an approximation was formulated of the time and temperature necessary to kill potatoes by such treatments, since it is conceivable that the time-temperature death curve for the potato might cross that for the infective agent of mosaic.

The hot-water treatments were carried out in a water-bath in tap water heated by an electric heater under thermostatic control, 28 tests being made at temperatures varying from 34·5° to 80° C. The potatoes came from definitely diseased mosaic or leaf roll plants. It may be calculated from the equation in which the averages of the results of the tests are expressed that at 70° C. the potatoes are killed in about 0·8 of a minute, at 60° in 7·218 minutes, at 50° in 65·1 minutes, and at 40° in 587·2 minutes. Indications are available that similar results are to be expected in killing potatoes in mercuric chloride solutions, so that the hot-water curve may serve as a rough guide as to the approximate duration of other forms of treatment. In general, potatoes treated at a time-temperature combination approaching that necessary for killing exhibited symptoms of black heart [see this *Review*, iii, p. 145], but at the higher temperatures, ranging from 60° to 100°, the tubers were apparently often killed before black heart had time to develop.

The hot-oven tests ranged from 35° to 120° C. No perceptible growth of sprouts occurred at the former temperature, but development was resumed when the potatoes were removed from time to time. After several months, however, the old sprouts assumed a yellowish tinge and the resumption of sprouting on removal became slower and more feeble. When the last potato was removed after 130 days, only two fine spindling sprouts developed in a month. Averaging the results of the tests, it was found that the time-temperature combinations for killing fitted roughly a curve which could be represented by the following empirical equation: $(y-8{\cdot}4255)(x-34{\cdot}5)^3 = 1{,}057{,}500$, where x is temperature in degrees centigrade and y is the time of treatment in minutes necessary to kill the potatoes.

All the tubers from mosaic or leaf roll plants that sprouted after the various treatments gave rise to diseased progeny. From the point of view of controlling these diseases, therefore, the treatment appears to have been a failure.

FOËX (E.). **Une pourriture verticillienne du tubercule de Pomme de terre.** [A *Verticillium* rot of the Potato tuber.]—*Ann. des Épiphyties*, ix, 2, pp. 121–133, 4 pl., 1923.

A tuber rot, which in 1919 caused some losses to the potato industry in Brittany, is described. It affected the variety Saucisse, and was visible externally as a depressed and well-defined patch round the point of attachment of the stolon. The infected area in the flesh of the tuber, of which the centre was frequently hollow and lined with a white mycelial growth, consisted of alternately black and white zones and reached at times beyond the centre of the tuber, though its diameter generally did not exceed 2 cm. The diseased region was thus much more localized than is usually the case with *Fusarium* or bacterial rots. In the tissues the mycelium is at first hyaline and intercellular, but later on it sends some branches into the cells, and the mycelial mass, which often reaches the density of a sclerotium, 25 to 200 μ in diameter, turns brown.

Though a few of the affected tubers when planted gave rise to fairly vigorous plants and healthy tubers, the author does not think it safe to conclude from his limited experiments that the trouble cannot be transmitted to the progeny, or that wilt cannot be produced in the latter.

The morphology of the causal organism and the cultural and inoculation experiments, which are fully described, showed that it was a species of *Verticillium*, which is referred to one of the numerous strains of *V. albo-atrum*, although its cultural behaviour and pathological action differed from that of an authentic culture of the latter received from Holland. The author points out, however, that the different strains of *V. albo-atrum* described by various investigators, whose work is discussed in some detail, are morphologically and culturally dissimilar in various particulars, and his form is not more unlike the Dutch culture than some of those studied by other workers. It is stated to be the first strain of this fungus found capable of causing a tuber rot. Inoculations with the two strains showed that the Dutch form was unable to infect the tuber, while that from Brittany penetrated the cork layers and entered the tuber readily, even when the latter was not wounded.

FOLSOM (D.). **Potato spindle-tuber.**—*Maine Agric. Exper. Stat. Bull.* 312, pp. 21–44, 8 figs., 2 diag., 1923.

The spindle tuber disease of potatoes [see this *Review*, ii, p. 387], which has been studied chiefly on the Green Mountain variety in Aroostook County, Maine, belongs to the group of 'degeneration' diseases (mosaic, leaf roll, &c.). The chief symptom is a change in the shape of the tuber, which becomes long, cylindrical except for the ends, which are tapering, with an irregular or bumpy outline and prominent eyes. Affected plants have erect, narrow shoots, with upright, dark green, and wrinkled leaves, which are smaller than normal, especially when the plants are mature. Infection late in the season may not affect the shape of the tubers, but the disease is transmitted by the latter and appears in characteristic form in the second year.

In other varieties the symptoms vary. In Irish Cobbler and Bliss Triumph the colour of the skin is affected, at least in certain

soils. The shape in Bliss Triumph and Rural is not much altered, though the outline is more irregular and the eyes more prominent, and even in Green Mountain the normal shape may sometimes be retained. In Spaulding Rose 4 the skin becomes lighter, but the leaves are less altered than in Green Mountain.

Spindle tuber is associated in some districts with marginal leaf roll and with growth cracks in the tubers, but, as in the other degeneration diseases, locality seems to influence the symptoms to some extent. It is stated to occur practically throughout the important potato-growing States. Curly dwarf disease in Green Mountain potatoes in Maine is believed to be a combination of this disease with one type of mosaic.

The apparent effect of spindle tuber on the yield of individual hills is a marked reduction, though exact data are difficult to obtain owing to the frequent association of the disease with mosaic and other forms of degeneration.

The disease is transmissible in the juice both from the above-ground parts and the tubers, and can be conveyed by aphids. It was shown by experiments, which are briefly described, that infection was transmissible to the extent of 83 per cent. by grafting together healthy and diseased tubers, and infection was also secured by stem grafting, by bruising the leaves and applying the juice of diseased plants to them, and by caging aphids from affected plants on healthy ones. The spread of infection from diseased to healthy plants was found to be facilitated by proximity. Samples taken in 1921 from the first row of healthy Green Mountain stock adjoining diseased stock produced 60 per cent. of infected plants in 1922, while those from a row a few yards distant produced plants with only 10 per cent. of infection.

The procuring and isolation of disease-free stocks appear more advisable as control measures than tuber or hill selection, removal of diseased hills, or attempts at insect elimination.

WERNER (H. O.) & HOWARD (R. F.). **Seed Potato investigations.**—*Nebraska Agric. Exper. Stat. Res. Bull.* 24, 58 pp., 10 figs., 12 diag., 1923. [Received 1924.]

It was apparent from tuber unit studies carried out in 1917–1918, in the course of an extensive investigation of Nebraska seed potatoes, on the Triumph, Early Ohio, and Pearl varieties, that a condition exists in western Nebraska seed stock which causes very rapid deterioration, as measured by yield and type of tubers. The condition was found to be tuber borne, variable in degree, and progressive in virulence. Irrigated stock appeared to be more severely affected than dry land seed grown at high altitudes. In 1922 the following yields were obtained: dry land seed, 100 per cent.; seed from potatoes irrigated one year, 85 to 90 per cent.; two years' irrigation, 60 to 75 per cent.; three and four years' irrigation, 40 to 65 and 40 per cent. respectively.

Affected tubers are elongated, cylindrical, and pointed at the bud end, in severe cases quite misshapen. The stolons are three to four times the normal diameter. The skin colour of red or pink varieties is abnormally pale and commonly yellowish or blotched, smooth and shiny. Russet varieties are frequently patchy, or

russeting may be entirely absent. In advanced cases the lenticels are numerous and conspicuous. The eyes are numerous, shallow, or even protuberant, their skin, in the Triumph variety, being deep red. Rudimentary leaflets are frequently produced on newly formed tubers towards the end of the growing season.

The plants are erect, stiff, and spindling, with few stems and practically no lateral branches. The leaves are small, slightly darker than the normal, erect, turned upwards along the midrib, and with wavy margins. Degenerate plants tend to bloom profusely, the dead flowers adhering much longer to the plant than in normal cases.

This condition closely resembles that known as spindling tuber [see last abstract] and a type of degeneration described by Stewart (*N.Y.* (*Geneva*) *Agric. Exper. Stat. Bull.* 422, 1916). There is no mottling or crinkling of the leaves as in mosaic and leaf roll, neither has a net necrosis of the tubers been observed. Spindling tuber also differs from mosaic and leaf roll in its influence on the tuber. A very definite correlation was found between this form of degeneration and low yields, no marketable tubers being produced by plants in the most advanced stages of the disease.

The data obtained in the investigations are regarded as yielding conclusive proof that the disease is transmissible by the tubers. Individuals showing typical symptoms of spindling never produce normal plants and tubers, while a tuber line strain from an affected tuber becomes progressively weaker, sometimes failing to produce plants at all. Low-yielding units were not restored to a normal condition by tuber line selection or by cultivation in a possibly more favourable environment. This form of transmission cannot, however, account for the amount and rapidity of the spread of degeneration in the field, and it is believed that contact between healthy and diseased plants, and possibly insects, may be largely responsible for the dissemination of infection.

The most practical method of control is to secure foundation stock from a vigorous strain of seed and plant it in an isolated plot at least 300 ft. distant from any other potato field, on land not used for potatoes for two or three years.

A bibliography of nearly 40 titles is appended.

Musser (A. M.) & Ludwig (C. A.). **Certified seed in Irish Potato production.**—*South Carolina Agric. Exper. Stat. Bull.* 218, 16 pp., 1923. [Received 1924].

The results of two years' preliminary trials in the use of certified, as compared with uncertified, seed potatoes in South Carolina, where the yield of the spring crop in each of the years 1921 and 1922 was over two million bushels, were uniformly in favour of the former method. The more important tuber-borne fungous and bacterial diseases partially controllable by the use of certified seed are enumerated and their symptoms briefly described. There was a slight increase of yield in all the certified lots and a very considerable reduction of the percentage of disease. In no case, however, should seed treatment with corrosive sublimate or formaldehyde be omitted.

Franchini (G.). **Sur un protozoaire d'Euphorbia cereiformis et sur sa culture.** [A protozoon of *Euphorbia cereiformis* and its culture.]—*Bull. Soc. Path. exot.*, xvi, 9, pp. 642–646, 3 figs., 1923.

The latex of a plant of *Euphorbia cereiformis* was found to contain a protozoon which was subsequently cultured on latex-bouillon, blood-bouillon, and blood-agar. Striking differences of shape and dimensions, details of which are given, were observed on the various media. Flagella, which were absent in the latex, developed in culture. The affected plant was abnormally pale and its latex was watery, with few and misshapen starch granules.

Franchini (G.). **Sur un flagellé d'une Asclépiadacée (Arauja angustifolia).** [A flagellate of an asclepiad (*Arauja angustifolia*).]—*Bull. Soc. Path. exot.*, xvi, 9, pp. 652–654, 2 figs., 1923.

The latex of a plant of *Arauja angustifolia* at Bologna was found to contain very motile flagellates differing in various respects from *Leptomonas elmassiani* discovered in the same plant in 1916 in Paraguay and later in Uruguay. The plant was obviously diseased, being almost entirely defoliated, with watery latex and a deficiency of starch granules; it died shortly after the inspection.

Franchini (G.). **Nouvelles recherches sur les protozoaires des plantes à latex.** [New researches on the protozoa of latex plants.]—*Bull. Soc. Path. exot.*, xvi, 9, pp. 655–659, 3 figs., 1923.

Besides *Leptomonas davidi*, trypanosomes, trypanosomides, Leishmaniform bodies, piroplasms, and the like have been discovered in different parts of Italy in the latex of *Euphorbia grandidens, E. nereifolia, E. officinarum, E. splendens,* and *E. virosa* (mostly cactiform species). Certain of the organisms observed are provided with pseudopodia. Special interest is considered to attach to the trypanosomes and amoeboid forms.

Mitchell (J.). **Ceylon Rubber Research Scheme. The work done in 1921–22.**—*Malayan Tin and Rubber Journ.*, xii, 15, pp. 929–930, 1923.

The Ceylon Rubber Research Scheme was established in 1921 for the purpose of investigating problems in connexion with the cultivation of rubber and the preparation of the raw material. During the period under review visits were paid to a large number of rubber estates throughout Ceylon.

Fomes lignosus was the most common root disease, but rarely serious. *Poria hypobrunnea*, *Fomes lamaoensis*, and *Ustulina zonata* were also of frequent occurrence, but caused little damage. Secondary leaf fall and pod disease [? *Phytophthora meadii*], on the other hand, has given rise to much anxiety, and a series of experiments to test the influence of fertilizers on this trouble are in progress. Black stripe canker [*Phytophthora* sp.] was very prevalent, but good control was secured by the disinfection of the tapped surface with brunolinum or izal. Patch canker [*Phytophthora faberi*], die-back (*Botryodiplodia theobromae*), and pink

disease [*Corticium salmonicolor*] were unimportant, the last-named, in particular, being very rare in Ceylon. Brown bast is steadily increasing, and there are grounds for believing that this disease may prove more serious than any other occurring in Ceylon.

La Rue (C. D.). **Helminthosporium heveae in Sumatra.**—*Phytopath.*, xiii, 11, pp. 483–487, 1923.

Helminthosporium heveae Petch, the cause of a widespread leaf spot disease of rubber, is usually confined to seedlings and young trees, but it was responsible for severe damage to old trees in Sumatra in 1919. Infection generally occurred while the leaves were still folded, spots being formed on the petioles, midribs, and laminae, and very occasionally on the bark of the young twigs. Wind-borne spores are believed to be the chief agent of dissemination.

Spores of the fungus produced in culture were found to be distinctly smaller than the dimensions given by Petch (average 47·44 μ against 100 to 200 μ). Taken from leaves the length was found to be chiefly between 80 and 114 μ, the mean spore width was 14·28 μ as against Petch's measurement of 15 to 18 μ, and the average number of septa 7, compared with 8 to 11. These differences may be due to environmental conditions, or the existence of separate strains of the fungus, or to measurement of the larger spores only in the earlier determinations.

Dodge (B. O.). **Effect of the orange rusts of Rubus on the development and distribution of stomata.**—*Journ. Agric. Res.*, xxv, 12, pp. 495–500, 1 pl., 1 fig., 1923.

A curious case of interaction between host and parasite is recorded in some detail. Blackberry (*Rubus* spp.) and black raspberry (*R. occidentalis*) leaves from various localities in the United States were found to develop an abnormally large number of stomata on the upper side as the result of infection by the gametophytic stage of *Gymnoconia* [*interstitialis*]. From one-quarter to one-half the total number of stomata on infected leaves were found on the upper side, where there are normally few or none. The development of spermogonia on leaves of primarily infected blackberries is frequently inhibited, aecidia alone being formed. The complete suppression of this stage in the life-cycle of a rust is stated to be a rare occurrence. Occasionally the aecidial stage may also be absent. The results of experiments clearly demonstrated the value of stomata on the upper side of the leaves in facilitating attack by the sporophytic germ-tube. Thus the gametophytic mycelium of the rust stimulates the host to provide ready means of access for the subsequent sporophytic stage.

Medalla (M. G.). **Diseases of Cane in the Philippines.**—*Sugar Central and Planters' News*, iv, 8, pp. 390–392, 1 fig., 1923.

A brief popular account is given of the principal diseases of sugar-cane in the Philippine Islands.

Fiji disease [see this *Review*, i, p. 187, and ii, p. 234] is very destructive, but so far occurs only over a limited area and may

be largely controlled by the cultivation of the resistant Badila variety.

Downy mildew [*Sclerospora sacchari*] has now been entirely eradicated from the Pampanga province.

Smut [*Ustilago sacchari*] is prevalent in Luzon, Mindoro, and the east coast of Negros, especially on the native varieties Luzon White and Pampanga Red. Louisiana Striped, Caledonia Ribbon, Badila, Lahaina, Rose Bamboo, Black Cheribon, Yellow Caledonia, and H-109 are all stated to be immune from this disease even in the most severely infected regions.

Yellow stripe or mosaic, prevalent throughout Negros and Luzon, may be controlled by the use of healthy cuttings.

Pineapple disease [*Thielaviopsis paradoxa*], to which the Pampanga Red variety is very susceptible, may be avoided by sett treatment, field drainage, and prompt planting. Luzon White and Badila are stated to be resistant.

The destructive 'sereh' and 'Lahaina' diseases, which have caused so much damage in Java and Hawaii respectively, are not yet known to occur in the Philippines, and rigorous plant quarantine regulations are now in force to prevent their entrance.

TAGGART (W. G.). **Station No. 1, Sugar Experiment Station, Audubon Park, New Orleans.** *Thirty-fourth Ann. Rept. Louisiana Agric. Exper. Stat. for 1922*, pp. 5–7, 1923. [Received 1924.]

About 1,700 of the 2,500 new sugar-cane seedlings supplied to the Audubon Park Station by the Bureau of Plant Industry remained free from mosaic in 1922 and have been replanted. Nine older seedlings and one foreign variety showed almost complete immunity, and the acreage planted with them was accordingly increased.

Comparative experiments in the cultivation of canes from healthy and mosaic diseased setts were conducted in co-operation with C. W. Edgerton. Canes germinated from disease-free setts came up healthy, but were infected by harvest time. The average yield from two tests with Purple Cane, using all healthy setts, was 16·54 tons, and that from diseased setts 15·78 tons. Healthy setts of the D-74 variety gave 13·59 tons and diseased setts 9·54 tons.

The results of selection experiments with the D-74, Purple, and L-511 varieties showed an increased yield of 3·42 tons with the first-named, 2·52 with the second, and 2·49 with the third, as compared with the general run of the crop.

BRANDES (E. W.), & KLAPHAAK (P. J.). **Growth stimulation and pest and disease control by hot-water treatment of Sugar-cane 'seed'.**—*Louisiana Planter*, lxxi, 19, pp. 371–372, 20, pp. 393–394, 4 figs., and 21, p. 412, 1923.

In July 1920 a series of experiments was instituted in the control of mosaic disease by immersion of the seed-cuttings in hot water for varying periods of time. It was found that neither immersion at high temperatures (45°, 50°, and 55° C.) for short periods (10 minutes to 2 hours) nor at lower temperatures (42°, 45°, and 48°) for long periods (up to 96 hours) controlled mosaic. The

stimulating effect of the former treatment, however, was remarkable. Three weeks after immersion the treated plants of the G. C. 701 variety were eight to nine inches tall, while the untreated controls averaged only about one inch. The remainder of the paper deals with the control of the cane borer and mealy bug by means of immersion.

LEE (H. A.). **Gum diseases of Sugar-cane in the Philippines.**—*Phytopath.*, xiii, 11, p. 504, 1923.

A vascular disease of sugar-cane occurring in the Philippines has been found to be identical with the bacterial wilt prevalent in Java described by Miss G. Wilbrink (*Arch. Suikerind. Nederl.-Indië*, xxviii, p. 1399, 1920). There is the same whitish, longitudinal streaking of the leaves, sudden wilting, reddened vascular bundles, and varietal susceptibility. The bacteria found in masses in the vascular bundles of affected canes agreed with the description of the Java organism. The disease is stated to be identical with the cane gummosis of Australia caused by *Bacterium vascularum* [see this *Review*, ii, p. 579], with the exception that there is no yellow bacterial ooze when affected canes are cut. Under Philippine conditions the varieties H-109, Lahaina, Negros Purple, and Louisiana Striped are severely attacked, while the Badila and Caledonia canes appear to be immune.

The only important diseases of the sugar-cane not yet known to occur in the Philippines are sereh and Lahaina disease.

WOLZOGEN KÜHR (C. A. H.). **Onderzoekingen aangaande de mikroflora aanwezig in normaal en serehziek Suikerriet.** [Investigations of the microflora present in normal and sereh-diseased Sugar-cane.]—*Meded. Proefstat. Java Suikerind.* 9, pp. 321–481, 16 pl. (3 col.), 1923.

This exhaustive study of the possible association of bacteria with the sereh disease of sugar-cane [see this *Review*, ii, p. 468] is introduced by an interesting summary of previous work on the occurrence of micro-organisms in the normal tissues of higher plants. The author then describes, in considerable detail, the technique of a new method for the examination of the microflora of normal and sereh-diseased cane. By means of a specially constructed press and the adoption of stringent precautions, it was possible to secure samples of expressed juice of normal and diseased canes for comparative purposes without risk of external contamination. The samples were cultured on various solid and liquid media.

The examination of the juice of 591 externally quite normal canes from various Java plantations showed that in nearly all cases saprophytic bacteria were present. Only in six canes of different varieties from a plantation situated at an altitude of 3,000 ft. were micro-organisms altogether absent.

Further investigations demonstrated the practically constant presence (98 per cent.) in sereh-diseased canes of an organism which was found to be identical with, or extremely closely related to, *Bacterium herbicola aureum* described by Burri and Düggelli (*Centralbl. für Bakt.*, Abt. 2., xii, p. 602, 1904), and found by them

and other investigators to be very commonly present on the surface of plants. The morphological and physiological characters of this organism are given in detail. The distribution of the other organisms found was as follows: *Aërobacter aërogenes* 27·5 per cent., *Bacillus mesentericus* and *B. subtilis* 21 per cent., *B. megatherium* 6 per cent., and miscellaneous microbes 32·5 per cent.

It was found that the reddish discoloration of the vascular bundles in young canes grown from sereh-infected setts coincided with the appearance of *Bact. herbicola aureum*, and the inoculation of a pure culture of the latter into normal canes resulted in the same symptom. Repeated inoculation experiments, however, failed to produce any of the other symptoms associated with sereh disease. It was, moreover, shown by further tests that similar symptoms could be produced by inoculation of different cane varieties with *Aërobacter aërogenes, B. mesentericus, B. megatherium,* and *Bacterium solanacearum.* The exposure of the stems to the action of various chemicals, including corrosive sublimate, Mohr's salt, phenol (5 per cent.), phosphoric, tartaric, sulphuric, oxalic, and malic acids, and potassium hydroxide also resulted in a similar discoloration. It seemed reasonable, therefore, to ascribe the symptom to the occurrence of a necrobiotic process in the dying tissues of the stems, followed by the absorption of the red colouring matter by the cell walls. The presence of acid appears to be an indispensable factor in the formation of the red substance, which is stated to be probably identical with, or very nearly allied to, purpurin (1 : 2 : 4-tri-hydroxy-anthraquinone).

It is pointed out that cultural conditions play an extremely important part in the reaction of sugar-cane to sereh disease. The results of a series of experiments showed that, under optimum conditions for cane cultivation, apparently quite normal plants were grown from heavily infected setts. At the same time it was definitely ascertained that the healthy condition of such canes was associated with the complete absence of *Bact. herbicola aureum*, which was originally present in the diseased parent setts.

The author does not clain to have thrown new light on the cause of sereh, but considers that a fresh line of research has been opened up and advocates the continuation of investigations by similar methods.

Tobacco division. Report for the year 1922.—*Canada Dept. Agric. Dominion Exper. Farms*, 58 pp., 5 figs., 1923. [Received 1924.]

The work of selection of tobacco varieties for resistance to root rot [*Thielavia basicola*] and other diseases has been continued. The very unsatisfactory results given by certain selections of imported White Burley have definitely shown that the resistance of strains of this variety is only relative. The Comstock Spanish variety showed a high degree of resistance to mosaic at Ottawa.

The results of seed-bed disinfection experiments at the Harrow Station showed that steam sterilization for 30 minutes at 100 lb. pressure is sufficient for the control of weeds and diseases. It appears that a good four-year rotation (tobacco, maize, cereal, and

grass) will eradicate slight infection by root rot. The results of varietal tests at this Station indicated that Routt's strain of Burley (CRB) and Snuff (SHRS) are resistant to root rot.

The blackfire or angular leaf spot disease [*Bacterium angulatum*] was first noted in Ontario during the late summer of 1922, when it practically destroyed the crop on two farms.

Decree restricting imports of flowering plants into Holland.

The Nederlandsche Staatscourant No. 179, of 17th Sept. 1923 publishes a Royal Decree of 27th August 1923 prohibiting the import into and transit through Holland during the period from 1st June to 31st October, of dried bulbs, tubers, and root-stocks of flowering plants, except those expressly approved by competent Dutch officials as free from insect and vegetable pests.

L'Oïdium américain du Groseillier. [American gooseberry mildew.] —*Ministère Agric. et Travaux publics, Bruxelles, Office hort., Avis aux Cult.*, 2e Série, 2, 5 pp., 1 fig., 1923.

By a ministerial Decree of 15th May 1923 provision is made for the destruction, at the owner's expense, of all gooseberry plants or fruits attacked by *Sphaerotheca mors-uvae*, which has made its appearance in Belgium. The Special Phytopathological Service and the Service of Horticultural Advisers have been entrusted with the execution of the provisions of the Decree.

The symptoms of the disease are briefly described and the following treatment recommended. Drastic pruning and destruction of all infected material during the dormant period, together with the application to the bushes and surrounding soil of 3 per cent. iron sulphate or Bordeaux mixture (3 per cent. copper sulphate and 2·5 per cent. of lime). The measures to be taken during the growing period include spraying the bushes from the time of the opening of the buds with liver of sulphur (0·2 per cent. for the first application and 0·25 per cent. for all succeeding ones) every 15 to 20 days. The treatment should be discontinued for three weeks before gathering, and renewed after the fruit has been picked.

The Antigua (Leeward Islands) Plant Protection Ordinance No. 16 of 1923. 5 pp., 31st December 1923.

This Ordinance, drafted with a view to the protection of sugarcane from mosaic disease, vests power in the Governor to prohibit, from time to time, the importation into the Presidency of any plants or parts thereof, soil, packages, coverings, or other articles to be specified by proclamation. Provision is further made for the inspection and registration of plant nurseries; for their quarantine if situated within a certain distance of infected trees or shrubs; and for the eradication of infected, or (if necessary to prevent the spread of disease) of healthy, plants. Compensation is provided for in the latter case. The Governor in Council is empowered to make regulations, *inter alia*, for the transit through the Colony of trees, shrubs, plants, soil, and the like; for the inspection of suspected material; and for the treatment of diseased trees or plants.

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PETRAK (F.). **Mykologische Notizen. VI.** [Mycological Notes VI.]—*Ann. Mycol.*, xxi, 3–4, pp. 182–335, 1923.

The author discusses [pp. 264–268] the various species of *Sclerophoma* recorded on different conifers and states that existing descriptions hardly allow of their identification, as they are frequently incomplete or erroneous. Thus, of the four species described by Diedicke (*Kryptfl. Mark Brandenb.*, ix, 1912) only the type species *Sclerophoma pityophila* (Cda) v. Höhn. is correct. *S. piceae* is incorrectly cited; *S. pityella* (Sacc.) Died. is identical with *S. pitya* (Thüm.) v. Höhn.; and *S. pitya* (Sacc.) Died. is synonymous with *Phoma pitya* Sacc., which according to Saccardo is a conidial form of *Diaporthe*, and which the author believes will be found to be a *Phomopsis*.

With respect to Van Luyk's view [see this *Review*, ii, p. 342] that the various species described are but forms of *S. pityophila* (Cda) v. Höhn., the author agrees that they are not morphologically distinct, but they may be limited to particular hosts and thus be biologically different forms. He further agrees with Van Luyk's view that in *Sclerophoma* the conidia are borne on the walls of the inner sclerotial cells. The genus is not separable from *Dothichiza* by any important characters and the type species is accordingly renamed *D. pityophila* (Cda) Petr.

Five new genera and several new species of fungi from Porto Rico collected by Fink and from the Philippine Islands collected by Reyes and Lee are described [pp. 306–317]. Among the latter *Leeina* n. gen. (Sphaeropsidaceae) was found on dry sugar-cane leaves, and it is suggested that *Cytospora sacchari* may be identical with this fungus.

A detailed description is given [p. 317] of *Pleospora bataanensis* n. sp. collected by S. A. Reyes on living and wilting leaves of *Agave cantula* in Luzon, Philippine Islands. It is not a typical species of the genus, to which it is only provisionally referred.

Diplodia agaves Niessl, which was found growing in association with *P. bataanensis*, is believed to be a conidial form of the latter.

It is a typical *Microdiplodia*, which is described and renamed *M. agaves* (Niessl) Petr. In the size and structure of the fructifications it shows a great resemblance to the ascigerous form with which it is associated.

Lasiodiplodia tubericola, described in 1896 by Ellis and Everhart on potato tubers imported into North America from Java, has been reported on various other hosts, including sweet potato tubers. The author's examination of material from Stevenson's herbarium indicates that the form on the latter is really identical with that on potato. The fungus, of which a detailed description is given, is regarded as a *Botryodiplodia* and renamed *B. tubericola* (Ell. et Ev.) Petr. The paraphysis-like filaments which occur in large numbers among the conidiophores in this fungus are also found in numerous other large-spored species and are not true paraphyses but merely conidiophores which remain sterile or elongate more or less after the abstriction of the conidia. The name 'pseudophysoids' is suggested for these filaments, which are not considered to be of systematic significance owing to their variability.

Horne (A. S.) & Williamson (Mrs. H. S.). **The morphology and physiology of the genus Eidamia.**—*Ann. of Botany*, xxxvii, 147, 23 figs., 1923.

Two new species of the genus *Eidamia* are described and their morphological and cultural characters compared in detail with those of the single species hitherto known, *E. acremonioides*, an amended diagnosis of the genus being furnished. It is thought probable that *Langloisula macrospora*, *Monopodium uredopsis*, and *Acremoniella atra* are identical and may prove to be synonymous with *E. acremonioides*. The latter has hyaline hyphae, conidiophores of the *Aspergillus* type, and large brown macrospores. The two new species, *E. viridescens* and *E. catenulata*, have coloured conidia on conidiophores which have a certain resemblance to those of *Verticillium*, while the last-named sometimes produces a typical *Penicillium* form of conidiophore. The conidia of *E. viridescens* are rarely in chains, being usually grouped at the tips of the pointed sterigmata. Both have colourless macrospores, smaller than those of *E. acremonioides*, and often formed intercalarly in the manner of chlamydospores. *Monosporium acremonioides*, *Papulaspora aspergilliformis*, and *Helicosporangium parasiticum* are given as synonyms of *E. acremonioides*. In the authors' cultures bulbils were not produced.

The reactions which the three species exhibit when grown in various media are described. The optimum temperatures for growth are *E. acremonioides* 20°, *E. viridescens* 25°, and *E. catenulata* 30° C. Both the new species hydrolyse starch, invert sucrose, decompose protein and asparagin with evolution of ammonia, and ferment certain sugars with acid production in the presence of protein. Both are able to utilize pectin and certain organic acids in the absence of other nutrients. In most of these respects they differ markedly from *E. acremonioides*, which is much less tolerant of a wide range of media. *E. viridescens* produces a volatile compound with an odour resembling that of coco-nut oil, in the presence of carbohydrate. The P_H limits for growth are *E. acre-*

monioides 3 and 8, *E. viridescens* 2 and 8·2, and *E. catenulata* 1·16 and 8·2.

E. viridescens was isolated from rotting apples and was found to be parasitic on apple fruit. *E. catenulata* was found on oak timber and was unable to infect apples.

EDGERTON (C. W.). **Blackfire and other Tobacco diseases.**—*Louisiana Agric. Exper. Stat. Exten. Circ.* 65, 7 pp., 1 fig., 1923. [Received 1924.]

During 1922 the blackfire or angular leaf spot disease of tobacco (*Bacterium angulatum*) appeared in Louisiana, where it is feared that it will become an important limiting factor in tobacco cultivation owing to the very favourable conditions existing in the State for its development and spread. In Virginia it reduced the tobacco crop by over 20,000,000 lb. in 1920, representing a financial loss of more than $5,000,000. Losses of 15 to 40 per cent. may be expected in heavily infected fields.

The symptoms of the disease are briefly described and the following control measures recommended: (1) seed disinfection with corrosive sublimate; (2) seed-bed sanitation, including annual change of situation, weekly applications of Bordeaux mixture beginning four or five weeks before transplanting, and thorough destruction of all diseased material; (3) rotation of crops; (4) prevention of spread by disinfection of workers' clothing and the like.

Mosaic disease does not at present cause very serious damage in Louisiana and should be largely preventable by the measures described above.

In order to avoid the introduction of the destructive wildfire disease [*Bact. tabacum*], the use of seed from other States should be discouraged. Such seed, if imported, should be treated with corrosive sublimate before planting.

CARNE (W. M.). **Spotted wilt of Tomatoes.**—*Western Australia Dept. Agric. Leaflet* 116, 2 pp., 1923. [Received 1924.]

The following observations have been made with regard to spotted wilt of tomatoes, due to an unknown cause, which since 1917 has been responsible for heavy losses in Victoria and other eastern parts of Australia.

Plants attacked early in the season usually die, while those infected late frequently recover. Late-sown plants are less liable to the disease than early-sown. Staking, pruning, and protection from sun and wind appear to reduce the incidence of the disease. Plants grown under insect-proof cheese cloth shelters were found to be free from attack when similar unprotected plants suffered severely. The small egg and cherry tomatoes are apparently immune. The pruning of affected parts and spraying have not given satisfactory control.

The chief symptoms of the disease are the development of brown or black spots on the upper leaves and brown streaks on the stems and pedicels, with subsequent wilting. There may also be more or less discoloration and decay of the fruit. The disease may be distinguished from sleepy sickness [see this *Review*, ii, p. 148] by the

normal condition of the roots, the absence of dark rings in the stem tissue, and the delayed maturing of the fruit, which in sleepy sickness ripens prematurely. In the latter disease, also, the lower leaves are first affected and are not spotted.

Hansen (T. S.), Kenety (W. H.), Wiggin (G. H.), & Stakman (E. C.). **A study of the damping-off disease of coniferous seedlings.**—*Minnesota Agric. Exper. Stat. Tech. Bull.* 15, 28 pp., 20 diag., 1923.

From 1914 to 1919 experiments were carried out at the Cloquet Forest Experiment Station to determine the best methods for controlling damping-off of the native species of coniferous seedlings in the Norway-Jack pine type of country, which forms a large proportion of the forest area of the Lake States.

To obtain rapid germination, seed should not be sown until the soil temperature is above 60° F. All things considered, late spring and early summer appear to be the most satisfactory times. Seed sown in the early spring is very liable to damping-off, while late planting produces poorly developed seedlings at the end of the first season.

Preliminary soaking of the seed did not markedly accelerate germination, while it did increase the injury from damping-off and therefore is not to be recommended. The seed should be covered as lightly as possible ($\frac{1}{8}$ to $\frac{1}{2}$ inch), a heavier covering leading to a reduction of germination and attacks of damping-off.

The results of fertilization experiments with tankage [débris from abattoirs dried and ground after removal of fat] and manure showed that the former materially reduced germination and increased damping-off. The differences between the manured and control plots were slight and variable, and no definite conclusions can be drawn from them.

In order to determine the effect of different degrees of shade on the development of the disease, plots were established with three-quarters shade, one-half shade, and no shade. The second was found to be the most advantageous, no benefit being derived from a removal of the shades after each rain.

The amount of watering did not materially affect the degree of injury from damping-off or fungicidal treatment. The use of sphagnum moss as a mulch increased germination and decreased damping-off, with the possible exception of Jack pine [*Pinus banksiana*]. A burlap mulch was beneficial to white pine [*P. strobus*] but detrimental to Jack pine, the Norway pine [*P. resinosa*] being unaffected.

Dense sowing of seed—up to 300 per sq. ft.—increased germination and reduced the incidence of damping-off. A crown of one inch in the surface of the bed improved drainage and decreased the amount of disease, except in the Norway pine.

The percentage of germination was lower, and the incidence of damping-off and injury from treatment with fungicides higher, in clay than in peat or sand, except that copper sulphate caused most injury in the last named.

The following were found to be the best treatments for the sterilization of seed-beds, to be applied at the time of sowing: for

white pine, $\frac{1}{4}$ oz. sulphuric acid per sq. ft.; for Norway pine and white spruce [*Picea canadensis*], $\frac{1}{2}$ oz. hydrochloric acid per sq. ft.; for Jack pine, $\frac{7}{16}$ oz. hydrochloric acid per sq. ft. The use of fungicides with white spruce is of very questionable benefit owing to the reduction of germination which they cause. The expense of applying the treatments in advance of sowing was disproportionate to the results obtained.

Part II of this paper (pp. 29–35), by Stakman alone, is entitled 'Fungi causing damping-off of coniferous seedlings in Minnesota'.

The disease was found to be due to the following facultative parasites, found more or less universally in the soil, and here given in order of prevalence: *Fusarium*, *Pythium*, *Rhizoctonia*, *Botrytis*, and possibly *Alternaria*. The organisms are frequently observed to be associated on the same host plant.

No conclusive evidence is available to indicate that one host species is more susceptible than another to the same organism, nor could the different types of injury be correlated with the presence of the various fungi found in the lesions. Each fungus acting alone or in combination is apparently capable of causing any or all of the different symptoms.

All the organisms, except *Botrytis*, were found in reduced numbers, but approximately the same relative proportions, in the treated beds.

GRAVES (A. H.). **The Melanconis disease of the Butternut (Juglans cinerea L.).**—*Phytopath.*, xiii, 10, pp. 411–434, 2 pl., 5 figs., 1923.

During the past 20 years butternut (*Juglans cinerea*) trees in Connecticut and other States have been observed to suffer serious injury from the attacks of a fungus provisionally identified in 1918 (*Mycologia*, xi, p. 111, 1919) as *Melanconium oblongum*.

The progress of the disease is generally slow, small branches gradually dying in basipetal succession; infection apparently proceeds from the distal end of the branch towards the trunk. The normal dark greenish-brown colour of the bark changes to reddish-brown and finally grey. The small, dark, smooth papillae studding the cortex rupture and expose the acervuli of the fungus, of which the only traces left a year later are minute, circular, or irregular holes in the loose outer bark. This *Melanconium* stage has dark olive-grey, continuous, oval conidia, 19 by 9 μ in diameter. A characteristic symptom of the disease is the succession of new, short branches developing further and further down the main branches. In the final stages of the disease the bare, grey wood of the dead branches in the upper part gives a typical stag-headed appearance to the trees. The basal shoots arising at this period soon become infected.

The morphological and cultural characters of the fungus are described. Besides the conidial stage of the Melanconiaceous type referred to above, black, spherical, or irregular pycnidia, 150 to 400 μ in diameter, and extruding in water enormous numbers of oblong, hyaline pycnospores, 3 by 1 μ, were found to develop in peptone and oat agar. In October 1920, long, black, hair-like perithecial necks developed from cracks in the bark of dead butternut twigs

incubated in a moist chamber. Cultures from ascospores, ejected from the asci through these openings, gave typical conidia of *M. oblongum* in 22 days on oat agar. The perithecia were found to be identical with those of *Diaporthe juglandis* E. & E., for which the name *Melanconis juglandis* (E. & E.) comb. nov. is substituted, a supplementary description being given. Inoculation tests, extending over a period of more than four years, are described in detail and have demonstrated conclusively that the fungus is a weak parasite. Usually entering through abrasions on small twigs, the mycelium grows slowly down through the wood, producing a dark discoloration, to the main branch and finally to the trunk, whence any branch may become infected.

No remedial measures are practicable for forest trees under present conditions, and diseased individuals should be removed during improvement thinnings. In the case of orchard or park trees, however, the disease may be combated by strict attention to sanitary measures, and by pruning off infected branches, the wounds being treated with tar or paint. Once the fungus has penetrated the trunk, control measures are useless.

SCHMITZ (H.). **Leaf cast of Larix occidentalis by Hypodermella laricis Tubeuf in north Idaho.**—*Phytopath.*, xiii, 11, pp. 505–506, 1 fig., 1923.

Leaf cast of the western larch (*Larix occidentalis*) caused by *Hypodermella laricis* was particularly severe in north Idaho in 1922, many of the stands presenting the appearance of having been ravaged by fire. In the spring of 1923 it was found that 29 per cent. of the leaf-bearing spurs on five branches picked at random had been killed. Dead branches were also common on infected trees.

It is pointed out that the name 'leaf cast' is a misnomer, in that the infected leaves, instead of being deciduous, remain on the tree till the following year.

MALENÇON (M.). **Sur un cas de parasitisme de Panus conchatus Bull.** [On a case of parasitism of *Panus conchatus* Bull.]—*Bull. Soc. Myc. de France*, xxxix, 2, p. 153–155, 1 fig., 1923.

Panus conchatus Bull. is sometimes found towards the end of autumn or in the winter on stumps of oak, beech, walnut, willow, poplar, &c., hastening their decay. Unlike other saprophytic fungi such as *Lenzites flaccida*, *Trametes gibbosa*, &c., *P. conchatus* attacks moribund, or recently felled trunks, in which the wood is still fresh. Nevertheless it is extremely rare to find it invading still living trees. A case has, however, been observed by the author in the forest of Meudon, near Paris, where the victim was a magnificent specimen of beech. Three main branches sprang from the trunk, of which one had been considerably injured during a storm in 1919. Fructifications of the fungus appeared on the injured limb in 1921, and these gradually covered the main trunk and the branch contiguous to the wounded one. In 1922 the tree was felled, and in its fall broke into several pieces owing to the rottenness of the wood. Only the third branch and the part of the trunk below it was still living at this time.

Doé (F.). **L'oïdium et les forêts feuillues du Nord-Est de la France.** [*Oidium* and the deciduous forests of the north-east of France.]—*Rev. Eaux et Forêts*, lxi, 10, pp. 429–436, 1923.

The ravages of oak mildew [*Microsphaera quercina*] in the north-east of France, as well as in Burgundy and Champagne, are stated to be rapidly wiping out the young ten to twelve-year-old oak plantations. Apart from direct remedial measures, the most promising method of control appears to lie in a modification of the present system of silviculture. In the author's opinion, the young oak plantations should be allowed, as far as possible, to grow into 'high forest', and not, as under the present system, be constantly 'regenerated' by means of sucker-shoots. The latter are highly susceptible to infection by mildew, which is thereby perpetuated, whereas among older and more resistant material it would probably die out.

Schmitz (H.). **Studies in wood decay. V. Physiological specialization in Fomes pinicola Fr.**—Abs. in *Phytopath.*, xiii, 11, p. 511, 1923.

The results of a physiological study of four cultures of *Fomes pinicola* obtained from four different hosts, namely, Douglas fir (*Pseudotsuga taxifolia*), white fir (*Abies grandis*), western hemlock (*Tsuga heterophylla*), and western white pine (*Pinus monticola*), showed marked differences in (1) growth characteristics; (2) rate of growth; (3) extracellular enzyme activity; (4) intracellular enzyme activity; (5) effects produced in mixed cultures; (6) growth in liquid media; and (7) nitrogen relations.

Bensaude (Mathilde). **A species of Olpidium parasitic in the roots of Tomato, Tobacco, and Cabbage.**—*Phytopath.*, xiii, 10, pp. 451–454, 5 figs., 1923.

The roots of tomato, tobacco, and cabbage plants in the greenhouse of Wisconsin University were found to be heavily infected by a fungus closely corresponding in morphological characters, which are briefly described, to *Olpidium brassicae* (Wor.) Dangeard. Infected plants developed quite normally, and the serious pathogenic action attributed by Woronin and other investigators to this fungus was not observed. It is possible, though not probable, that the Wisconsin *Olpidium* differs in certain respects from the European species; otherwise it would seem doubtful whether previous investigators were justified in ascribing to the latter the blighted condition of cabbage and tobacco seedlings stated to have been associated with its presence.

This is believed to be the first reference to *Olpidium*, as a root parasite, in American literature.

Harter (L. L.) & Jones (L. R.). **Cabbage diseases.**—*U.S. Dept. of Agric. Farmers' Bull.* 1351, 28 pp., 14 figs., 1923.

The following fungous diseases of cabbage and other Cruciferae in the United States are described and figured.

Club-root (*Plasmodiophora brassicae*), which occurs principally on moist, acid, poorly drained soils, may be controlled by the application of slaked lime at the rate of 75 bushels per acre every

few years. The Hollander variety and blue and red cabbage are more resistant to the disease than Succession.

Black rot (*Bacterium campestre*) has been reported from practically all States east of the Mississippi and from several to the west, especially Iowa and Nebraska, and the losses caused by it probably exceed those from any other disease. It may be controlled by seed disinfection with corrosive sublimate and such cultural measures as rotation of crops, destruction of infected plants, and the like.

Yellows (*Fusarium conglutinans*), which may cause a loss amounting to 90 per cent. of the crop in the area from Long Island to Iowa and Kansas, can be controlled to some extent by seed disinfection and careful sanitation, but the only real safety lies in the use of resistant varieties, such as Volga, Houser, Wisconsin Hollander, All Seasons, and Brunswick. It is now known, however, that very young seedlings of resistant varieties are highly susceptible to yellows if the soil temperature exceeds 60° F., and it is essential to use disease-free soil for the seed-bed.

Blackleg (*Phoma lingam*) occurs very generally in most States east of the Rocky Mountains where cabbage has long been grown. In neglected gardens the losses from the disease may amount to 50 to 100 per cent. Disinfection of the seed by corrosive sublimate reduces infection, but complete eradication can only be secured by immersion in hot water at 122° F. for 30 minutes, a treatment which may cause some reduction of germination. The use of clean soil for the seed-bed, or the sterilization by steam of old soil, is also recommended, besides the usual cultural measures.

Soft rot (*Bacillus carotovorus*) causes severe losses, sometimes amounting to 25 to 50 per cent., among stored cabbage in New York and Wisconsin. It is recommended that the temperature of storage houses should be maintained at one or two degrees above freezing, with a comparatively low relative humidity.

Root rot or wilt occurs on heavy, flat, poorly drained land, on which heavy rains easily cause surface flooding. This saturation of the ground, followed by hot, sunny days, causes the destruction of the fibrous roots from lack of oxygen.

Malnutrition, the most characteristic symptom of which is a light green or yellow discoloration of the intervenal and marginal portions of the leaves, may be due to (*a*) the excessive use of mineral fertilizers; (*b*) the lack of humus; or (*c*) the accumulation of acids in the soil. It can be remedied by the application of air-slaked lime at the rate of 1,000 to 2,000 lb. per acre, while humus can be supplied by the use of stable or green manure. The disease is most important in the southern States, where mineral fertilizers are used in order to produce larger and earlier crops.

Downy mildew (*Peronospora parasitica*) and white rust (*Albugo candida*) [*Cystopus candidus*] are seldom sufficiently important to justify control measures. In serious cases of the former spraying with Bordeaux mixture may be necessary.

Drop or watery soft rot (*Sclerotinia libertiana*), which causes heavy losses in the Gulf Coast region, southern Alabama, parts of Florida and Texas, and occasionally in the northern States, may be controlled by crop rotation, in which care should be taken to

avoid the sequence of lettuce and potato, and by proper cultural measures.

Spot disease of cauliflower (*Bact. maculicolum*), which also occurs to a limited extent on cabbage, is characterized by the appearance of small, brownish to purplish-grey spots, chiefly on the lower surface of the leaf. It is most prevalent in cool, damp weather. No control measures have been worked out.

Black leaf spot or mould (*Alternaria brassicae*), a common storage disease, may be controlled by disinfection of the storage house with Bordeaux mixture; careful handling of the heads to avoid injury; keeping the temperature at one or two degrees above freezing; and proper ventilation to ensure low humidity.

Ring spot (*Mycosphaerella brassicicola*) is most prevalent on the Pacific Coast, especially on cauliflowers. Spraying with Bordeaux mixture, careful sanitation, and appropriate storage conditions (as outlined above) are recommended.

Powdery mildew (*Erysiphe polygoni*) is seldom of sufficient importance to justify control measures.

Damping-off, due to various fungi, may be prevented by seed disinfection and cultural measures, the latter including the frequent stirring of the upper soil layer; free circulation of air and exposure to sunshine; watering in the morning; and sprinkling a layer of fine sand over the surface of the soil.

CAMPÁNILE (GIULIA). **Sulla Phoma betae Frank como agente della moria della bietole nei semenzai in Italia.** [On *Phoma betae* Frank the cause of Beet blight in Italian seed-beds.]—*Boll. mensile R. Staz. Pat. veg.*, iv, 4–6, 1 fig., 1923.

To the author's knowledge *Phoma betae*, though very destructive in France and Germany, has not previously been recorded on beet [*Beta vulgaris*] seedlings in Italy, but the omission is probably due to lack of observation and to the fact that seedlings attacked by *Pythium de Baryanum* are more conspicuous than those infected by *Phoma betae*. She believes that the latter fungus must be held responsible for the very severe epidemics which occurred in Italy in 1901 and 1903. The fungus has now been found on seed raised in Italy.

The characters of the Italian disease are described. The growing tips of the rootlets issuing from the infected seed ball blacken considerably, and this discoloration runs along the hypocotyl to the cotyledons, which usually remain imprisoned in the seed ball and become rotten. The disease progresses along the fibro-vascular bundles, which stand out black against the almost transparent yellowish tint of the rootlet and hypocotyl tissues, the latter retaining their turgescence for some time. This contrasts with the flaccidity of the tissues, followed by browning, in rootlets invaded by *Pythium de Baryanum*. As soon as the tissues lose their turgescence, and sometimes earlier, the mycelium forms pycnidia, which when mature and under suitable conditions of moisture emit a gelatinous tendril of hyaline, oval, non-guttulate spores. While the pycnidia are still immature they are covered with hyaline mycelial appendages, with a particularly dense, beak-like cluster round the ostiole. The appendages gradually disappear, the beak-

like cluster being the last to go, and ripe pycnidia are perfectly smooth. Although infection can generally be traced to the presence of pycnidia on the seed balls, cases were observed where seedlings from apparently healthy seed developed the trouble. The spores, owing to their gelatinous coating, are probably able to adhere to the seed and may remain viable for long periods without their presence being detected.

To control the disease, methods of cultivation calculated to improve the vigour of the plants are useful, but seed disinfection is the main hope. Several methods of seed disinfection are discussed, of which immersion in a 2 per cent. copper sulphate solution is stated to have proved most efficient in other countries. Drying the seed and sprinkling it before sowing with carbonate of lime is also recommended, as it is stated to improve the vigour of the seedlings. The Italian practice of soaking the seed in water just before planting to accelerate germination is deprecated as favouring infection by *P. betae*.

BOYLE (L. W.). **Fusarium rot of Onions.**—Abs. in *Phytopath.*, xiii, 11, p. 510, 1923.

Heavy losses are caused by a rot of onions in parts of Washington, especially during storage and transit. Field specimens showed wilted and brown tops, but the bulbs were often of normal appearance until cut. The tissues had a solid, water soaked appearance, extending for a varying distance along individual scales from the base upwards. Sometimes a soft rot occurred which was also confined to individual scales, the tissues having a brown, slimy appearance; this condition is believed to be secondary to the water soaked stage. The roots were readily detachable. In advanced stages of soft rot there was a heavy ring of white, fungous growth round the base, which invariably bore *Fusarium* spores. Bacteria and fungi were isolated from the soft, brown, rolled tissue near the base of the bulb scales, and pure cultures of *Fusarium* from the solid tissues at the edges. It is not yet known what part is played by the different organisms in the causation of the disease.

PARKER (C. S.). **Notes on the anthracnose of Lettuce.**—Abs. in *Phytopath.*, xiii, 11, p. 510, 1923.

Marssonia panattoniana was isolated from volunteer head-lettuce plants, showing symptoms of anthracnose, in the autumn of 1922. During the winter spores from the pure cultures were sprayed over the leaf surfaces of *Lactuca scariola* and perfect infection was obtained. Early in 1923 typical anthracnose lesions were observed along the midrib of *L. scariola* growing wild in the open, and the fungus was isolated from these.

MARSAIS (P.). **Maladie de l'esca.** [The 'esca' disease.]—*Rev. de Vitic.*, lix, 1514, pp. 8–14, 1 col. pl., 1923.

This paper is based on notes taken by the writer at Viala's lectures at the Institut National Agronomique, Paris.

The 'esca' disease, also known as apoplexy of the vine [see this *Review*, i, p. 416, and ii, pp. 326, 437], is believed to be of extremely remote origin and has been observed in the Peloponnesus, Italy, France, Lorraine, the Balkan States, and the East.

A study of the causal organism has been conducted at the Viticultural Research Station, Paris, where it was recently shown that tannin-containing media, such as pyrogallic acid agar, provide the best conditions for growth. A reduction in the tannin content of the medium retards the development of the fungus. The wood of old vines and chestnuts, which was found to be very rich in tannin, also afforded an excellent medium.

The mycelium of the fungus only penetrates the wood after the latter becomes discoloured from the oxidation of the tannin by an oxydase secreted by the mycelium and diffusing in advance of its growth. The mycelium advances by successive 'pushes', but requires a minimum of three or four years to invade the whole of the central cylinder from the pith where it first accumulates.

With the invasion of the outer zone of the central cylinder, coincide the first external symptoms (sudden leaf fall, death of the branches, &c.), which therefore appear long after the fungus is well established. The mycelium appears to be unable to penetrate living tissues but develops in quantity in those killed by the enzyme which it secretes, replacing the solid woody tissue by a light mass of fungus of the 'amadou' type.

It was found that the tannin content varied considerably with the age of the vines, reaching its maximum in those of 25 to 30 years. Hence the greater liability of older vines to the disease and the apparent absolute immunity of trees under 10 years of age. The susceptible Rupestris variety is also much richer in tannin than the comparatively resistant Riparia. In certain soils, particularly those rich in organic matter, the tannin content of the vine is increased, and under these conditions the infection pursues a more rapid course and is accompanied by external symptoms somewhat resembling those of court noué [see this *Review*, iii, p. 75] from the first years, death being gradual, not abrupt.

The symptoms of the disease on the leaves, which have been reproduced in inoculation experiments on young vines, include curling, mottling, a diaphanous texture, and an abnormally close arrangement of the veins. On older vines the leaves assume a dingy grey hue and in severe cases desiccation also occurs. Lighter attacks are characterized by red or yellow mottling, or by a reddening of the edges of the leaves and of the intervenal portions.

Besides *Fomes igniarius*, a second fungus with similar mycelial characters is frequently associated with the 'esca' disease. This is *Stereum hirsutum*, which is stated to be the commoner and more dangerous of the two. It is described in some detail. Sporophores are rarely produced on the diseased vines, and dissemination probably occurs by the conidia which are formed on the mycelium. A kind of sclerotium is also often developed in culture, and small portions of these sclerotia readily become detached and may reach the pruning wounds and other lesions through which infection occurs.

In the south of France excellent results in the control of 'esca'

have been secured by the application to the vines of arsenical compounds, which have also been found to be highly toxic to the fungus in culture. Young vines, and those cultivated in conditions unfavourable to the disease, need only be treated in alternate years, or even every two or three years. Soluble arsenites give the best results and are applied by sponging or brushing the solution on the pruning wounds. Spraying the solution on the vines is also much practised.

Güssow (H. T.). **The aims and organization of the Plant Pathological Service, Dominion of Canada.**—*Intern. Rev. of the Sci. and Pract. of Agric.*, N.S., i, 3, pp. 595–599, 1923.

Owing to the extremely varying climatic conditions and the vast extent of the Dominion of Canada, and in order to keep in the closest possible touch with the actual growers and their problems, the Plant Pathological Service has established chains of laboratories from north to south and east to west, which have made it possible to maintain a very close yearly plant disease survey. The whole of this work is directed from the Dominion Botanist's office and central laboratories at Ottawa, which serve as an inquiry bureau for the cultivators of all kinds of crops throughout the Dominion. In addition, research work is undertaken on special phases of plant pathology and physiology, and inspection under the Federal Destructive Insect and Pest Act is centred at headquarters. Another very important branch of its activities comprises the direction of a Dominion-wide system of field and tuber inspection of potatoes for seed purposes, certificates being granted on a high standard of freedom from disease. The extent of this work, which has been in progress for eight years, can be gathered from the fact that, in 1922, 11,250 acres of potatoes located in various districts throughout the country were inspected, with the gratifying result that large quantities of seed potatoes are now produced practically free from disease.

An account is given of the different branch laboratories and their work. At Charlottetown, Gulf of St. Lawrence Province, mosaic, leaf roll, and other diseases of root and truck crops are being studied. The laboratories at Fredericton, New Brunswick, and at Ste. Anne de la Pocatière, Quebec, are maintained for the study of general pathology, with special reference to local needs. Research work on fruit crops is carried out at Kentville, N.S., St. Catherine's, Ontario, and Summerland, B.C., where various diseases and their control are being investigated. Another group of laboratories, those at Brandon, Man., and at Indiana Head and Saskatoon, Sask., is situated in the grain belt, where the annual produce of wheat, oats, barley, and flax is valued at over 650 million dollars. Black stem rust of wheat [*Puccinia graminis*] is receiving special attention, and active propaganda for the eradication of barberries and other alternative hosts is being carried out. Research has recently revealed the existence in Canada of a large number of biologic strains of *P. graminis*, and it is hoped that this discovery will facilitate the breeding of rust-proof varieties of wheat.

VAN POETEREN (N.). **Verslag over de werkzaamheden van den Plantenziektenkundigen Dienst in het jaar 1922.** [Report on the activities of the Phytopathological Service in the year 1922.]—*Versl. en Meded. Plantenziektenkundigen Dienst te Wageningen* 31, 57 pp., 1923. [Received 1924.]

Among the many references of phytopathological interest included in this Report, which has been prepared on similar lines to that for 1920–21 [see this *Review*, ii, p. 52], the following may be mentioned.

Phytophthora cactorum was recorded on apples, pears, and apricots. A species of *Fusarium*, probably *F. gemmiperda*, was responsible for the premature decay of buds on apples, while both apples and pears were attacked by *Roesleria hypogaea*. *Cladosporium carpophilum*, hitherto little known in Holland, occurred on Waterloo peaches, and vigorous cherry trees were suddenly killed by an organism believed to be identical with *Bacillus spongiosus*. Raspberries were attacked by a species of *Fusarium* causing the discoloration and rupture of the cortex. It is not yet known whether this fungus is also responsible for an obscure raspberry disease in the Breda district with which *Coniothyrium fuckelii* has been associated. Gooseberries and currants were heavily infected by the *Caeoma* stage of *Melampsorella ribesii-viminalis*. Westland and German sour red currants suffered from a wilt disease, accompanied by swellings and rupture of the cortex, and believed to be due to *Verticillium dahliae*. Excellent results in the control of gooseberry mildew [*Sphaerotheca mors-uvae*], which occurred on 52 per cent. of the inspected area, were given by the application, early in May, of Burgundy mixture.

Complete control of wheat bunt [*Tilletia tritici* and *T. levis*] was given in field experiments by the use of copper sulphate, 200 gm. in 2·5 l. water per hectol. grain ; uspulun, 1 and 2 per cent., 8 and 4 l. water per hectol. grain respectively ; germisan, 0·5 per cent., 12 l. per hectol., and 1 to 4 per cent., 4 l. per hectol. ; corrosive sublimate, 0·5 per cent., 2·5 l. per hectol. ; and formalin 0·25 per cent., 5 l. per hectol. The two control plots had 104 and 140 bunted ears in 10 sq. m. respectively. Rye and oats suffered from various physiological disturbances frequently associated with cultivation on reclaimed land. Excellent control of stripe disease of barley [*Helminthosporium gramineum*] was given by uspulun and germisan, copper sulphate being slightly less reliable.

Potatoes were attacked with unusual severity by *Sclerotinia libertiana*. A spotting of the leaves resembling that caused by *Alternaria* [*solani*] persisted in the progeny of one particular seedling, and investigations are in progress to ascertain whether the disease is seed borne. *Phytophthora erythroseptica* was also reported, while wart disease [*Synchytrium endobioticum*] was very severe in 1922, the total infected area in Holland now covering nearly 410 hect.

Flax in north-west Brabant displayed symptoms reminiscent of those of heat canker [see this *Review*, ii, p. 313], while a species of *Fusarium* (probably *F. lini*, not previously recorded in Holland) caused the death of plants in the Friesian districts. Another flax disease new to Holland was that caused by *Polyspora lini*.

Beets were heavily infected by *Pleospora putrefaciens,* which formed spots all over the leaves. Sugar beets from Groningen showed a black discoloration of the vascular bundles, associated with, but not definitely traced to, the presence of bacteria. The sugar-content of infected individuals was slightly above the normal.

The results of experiments in the control of *Verticillium albo-atrum* and *Rhizoctonia solani* in tomato seed-beds with cresol and carbolic acid (0·5 l. in 20 l. water per sq. m.) were not satisfactory, heavy infection occurring on the treated plots. In certain cases the application of these substances even appeared to predispose the plants to excessively severe infection. Ammonium carbonate and copper sulphate also failed to control *V. albo-atrum* on tomatoes, but gave excellent results with the same organism on melons and with damping-off (presumably due to *Pythium de Baryanum*) on *Selaginella.*

Among the many interesting miscellaneous records may be noted *Pseudomonas juglandis*, associated with a species of *Fusarium*, on walnuts; a severe attack of mildew (*Peronospora arborescens*) on blue maw bird-seed [*Papaver somniferum*]; the occurrence of a species of *Fusarium* on scarlet runner beans at Sappemeer, and of a disease believed to be due to *Bacterium pisi* on peas.

Potassium-resin soap (consisting of 1 part by weight of resin, half a part of potassium carbonate, and 1½ parts of water) gave excellent results as a 'spreader' with Bordeaux or Burgundy mixture.

TUCKER (C. M.). **Report of the acting plant pathologist.**—*Ann. Rept. Porto Rico Agric. Exper. Stat. 1922*, pp. 16–18, 1 pl., 2 figs., 1923. [Received 1924.]

Rice plants were attacked by a fungous disease, the earliest symptom of which was the appearance of a brown ring immediately below the first leaf sheath. Small, oval, brown spots, extending through the tissue, were formed on the young leaves, which frequently died. The roots of infected seedlings turned brown and rotted. In some cases the seedlings were killed by root infection alone. In test-tube cultures all the seedlings with affected roots died, while a few recovered when only the leaves were attacked. A grey mycelium, bearing abundant spores, appeared on the roots and collar of dead seedlings. As the plants matured, oval or elongated, dark brown spots, in the centre of which was the greyish mycelium, developed on the leaves. On the grain minute, circular or oval, dark brown spots appeared, which were sometimes so deep that polishing failed to remove them. Many of the seeds from diseased plants germinated poorly and were covered with mycelium. More than half the infected seedlings showed symptoms of disease both on the root and coleoptile. Of 207 infected seedlings, 176 died before reaching a height of six inches. Examination of the mycelium from diseased seed, seedlings, roots, &c., proved it to be in all cases a species of *Helminthosporium*, which was isolated and grown in pure culture, but not identified. Secondary infections are believed to occur on the leaves and heads from the primary seedling infections which result from sowing diseased seed.

Disease-free seeds planted in an isolated position in the field produced apparently healthy seedlings, which, however, developed the characteristic symptoms of the disease when they were six to ten inches high. This type of infection seems to be less virulent than seedling infection and was not traceable to the soil, in which no rice had been grown for a considerable period. Preliminary results indicate that disinfection of the seed with chemicals is of little value in controlling the disease, the selection of seed from healthy plants being a more promising method.

Grapefruit trees in the Manati section are stated to be dying in great numbers from a disease which apparently originated in a single tree and thence spread in all directions. Affected trees assume a chlorotic appearance accompanied by 'frenching' of the young growth. No benefit has been derived from spraying with ferric or copper sulphate or the application of various fertilizers. The constant presence on diseased roots of a species of *Fusarium* was demonstrated. The organism grew rapidly and produced a copious white mycelium on sterilized grapefruit roots, but no symptoms of disease could be induced in freshly-cut roots placed in contact with infected material.

The horticulturist states (p. 8) that vanilla plants were attacked by a root disease, believed to be due to species of *Fusarium*.

The assistants in plant breeding and horticulture mention (p. 12) a *Helminthosporium* disease of Indian wheat causing a shrinkage of the kernels and reduction of the grain yield.

Banana plants selected for resistance to Panama disease [*Fusarium cubense*] made slightly more vigorous growth than unselected plants. The application of tobacco stems and wood ashes to the soil had no apparent effect either on the development of the plant or that of the disease.

Report of the Superintendent, Kentville (N.S.) Experimental Station, for the year 1922.—*Canada Dept. Agric. Dominion Exper. Farms*, 83 pp., 4 figs., 1923. [Received 1924.]

All peach, plum, and cherry trees were sprayed on 7th April 1922 with lime sulphur (1 in 9), mainly for the control of peach leaf curl [*Exoascus deformans*], with good results. Tests on the spraying and dusting of apple trees (chiefly McIntosh and Gravenstein) were started on 22nd May, just after the opening of the buds. The Bordeaux mixture used in the tests consisted of 4 lb. copper sulphate, 8 lb. lime, and 40 galls. water, the excess of lime over copper having been found to obviate the yellow discoloration characteristic of the old 4–4–40 formula. Lime-sulphur was used at the rate of 1 in 39, 10 lb. hydrated lime being added to 100 galls. of the mixture. 'Emulso', a new spreader which was added to the sprays in some of the tests, resulted in a more even distribution of the liquid but did not improve the control of scab [*Venturia inaequalis*]. Dusting is becoming increasingly popular in the Annapolis Valley, Nova Scotia. Sulphur arsenate, composed of 90 lb. sulphur and 10 lb. lead arsenate, and copper arsenate, consisting of 12 lb. dehydrated copper sulphate, 8 lb. arsenate of lime, and 80 lb. hydrated lime, were both used in the tests. The latter gave the best results. The average cost of the operations (three

applications to one acre of 40 trees) was as follows: copper arsenate dust \$13·56; sulphur arsenate dust \$17·82; 4–8–40 Bordeaux arsenate \$16·48; and lime-sulphur arsenate \$12·29. The average amount of scab on the dusted plots was 12·22 per cent. and that on the sprayed plots 3·57 per cent. Bordeaux mixture proved more effective than lime-sulphur.

Cherry leaf spot [*Coccomyces hiemalis*] was effectually controlled by two applications of lime-sulphur: 1 in 9 early in April and 1 in 50 when the petals had fallen, followed by sulphur dusting a fortnight later.

Brown rot of plums [*Sclerotinia cinerea*], which is apt to cause very considerable losses at harvest time, may be partially controlled by the following spray schedule: lime-sulphur 1 in 50 (*a*) soon after the blossoms drop, (*b*) a fortnight later, and (*c*) a month before the fruit is ripe; followed by sulphur dust 10 days before ripening.

Celery rust [*Puccinia apii*] was very severe and evidence was obtained of its transmission by the seed. Golden Self-Blanching was immune throughout the season.

Little or no benefit was derived from the application of sulphur (inoculated and otherwise) or gypsum for the control of potato scab [*Actinomyces scabies*].

Experiments were carried out to test the value of different seed treatments for the control of smut in Huron wheat, No. 80 barley, and Liberty and Irish King oats. A formaldehyde spray absolutely controlled the disease in Irish King oats and reduced it to a trace in Liberty. Copper sulphate (crystal 1 lb., salt 1 lb., water 5 galls., 10 minutes immersion, followed by 10 minutes soaking in 1 lb. quicklime to 10 galls. water) reduced infection to a trace in Liberty oats but failed to control it entirely in the other cereals tested. Copper carbonate dust (2 to 3 oz. per bushel) gave very good control with Liberty oats. Copper sulphate and nickel carbonate dusts, san-o-san [? seed-o-san] and chlorophol were less satisfactory.

The application of varying quantities of lime for the control of club-root of turnips [*Plasmodiophora brassicae*] did not give encouraging results. The Bangholm variety was resistant.

HEALD (F. D.). **Division of Plant Pathology.**—*Thirty-third Ann. Rept. Washington Agric. Exper. Stat. for the fiscal year ended June 30, 1923*, pp. 40–49, 1923. [Received 1924.]

Experiments to test the value of dusts for the control of bunt (*Tilletia tritici*) in autumn seedings on summer fallow were continued on a plan similar to that of the previous year [see this *Review*, ii, p. 264] and gave, in general, confirmatory results.

The copper sulphate plots, though showing only 53·4 per cent. germination, equalled the yield of those in which there was no reduction of germinative capacity. In this series of tests no increase of yield was obtained from the copper carbonate treatment.

Twenty-two $\frac{1}{50}$ acre plots showing infection varying from 10·7 to 29·4 per cent. according to head counts gave yields per acre

from 42·2 to 51·5 bushels, indicating that this method of counting does not provide a reliable index of the reduction in yield.

More copper carbonate dust was found to adhere to Bluestem than to Marquis wheat, but adhesiveness was not found to be an accurate measure of the efficacy of a given compound.

In 108 tests with 9 brands of pure copper carbonate, perfect control was obtained in 60, the average amount of infection for the whole series being 0·39 per cent. In 48 tests with 4 brands testing 20 per cent. or less of metallic copper there was an average of 1·28 per cent. bunt, perfect control being secured in 14. In 12 untreated samples there was an average of 27·5 per cent. infection. The results of this and previous experiments indicate that 3 oz. of pure copper carbonate or 4 oz. of the weaker preparations per bushel should be used for autumn seedings. For spring seedings 2 to 3 oz. of the former or 3 to 4 oz. of the latter should be used, according to the degree of infection.

Anhydrous copper sulphate dust, with or without chalk or lime, was much inferior to copper carbonate on heavily infected seed.

Nickel carbonate (2 and 3 oz. per bushel) was inferior to the same quantities of copper carbonate. Du Pont dust No. 1 (2 and 3 oz. per bushel) gave 0·7 per cent. infection in 12 tests and Du Pont dust No. 2 0·65 per cent. Furfural (0·5 per cent. for 10, 30, and 60 minutes) gave no protection against bunt, but did not reduce germination.

During the period under review bunt of wheat was extraordinarily prevalent, untreated fields having 50 per cent. or more, while even with carefully treated seed 20 to 30 per cent. was sometimes found.

Foot rot of wheat [*Ophiobolus cariceti*] was extremely prevalent in the Spokane Valley in 1923, in marked contrast to 1922 when the disease was completely absent. The heavy incidence of infection is believed to be due to the sharply alternating cold and mild periods characterizing the winter of 1922–23, followed by heavy spring rains.

Further tests were conducted to ascertain the best method for the control of covered smut of oats (*Ustilago levis*) on the Swedish Select (moderately susceptible) and Abundance (resistant) varieties. The seed was artificially smutted and treated with 3, 6, and 8 oz. copper carbonate per bushel and with the standard formaldehyde solution. Copper carbonate gave very good, and formaldehyde perfect, control, but the incidence of infection was not high even in the untreated controls.

Copper carbonate proved useless for the control of *Rhizoctonia* [*solani*] and when applied to moist tubers before cutting was actually detrimental to the vitality of the seed.

It has been shown that leaf roll, at least two kinds of mosaic, streak, and spindling tuber are widespread in potatoes throughout the State, and it can now be positively stated that various symptoms formerly attributed to *Rhizoctonia* are really only phases of the different virus diseases.

Cuttings from tomatoes affected by yellows or western blight [*Fusarium* sp.] gave very stunted plants which produced an

abnormal quantity of fruit, though definite symptoms of the disease did not appear.

A study of the winter injury of fruit crops has shown that silver leaf (*Stereum purpureum*) is probably a marked contributory factor.

It is stated that the *Fusarium* rot of onions prevalent in the Walla Walla district [see above p. 314] is possibly due to *F. malli* though the latter has not previously been reported to cause a bulb rot.

Notes on various other diseases, several of which have not been recorded in Washington previously, are given. *Sclerotium rhizodes* [see this *Review*, iii, p. 267] is stated to cause a blight or winter killing of wheat.

Botany and plant pathology.—*Thirty-sixth Ann. Rept. Pennsylvania Agric. Exper. Stat. for the year ending June 30, 1923,* pp. 13–16, 1923. [Received 1924.]

Apple blotch [*Phyllosticta solitaria*] is stated to be apparently increasing in virulence in Pennsylvania. Infection started so early in 1922 that the regular spraying programme failed to control the disease. Petiole infection was evident on 23rd May, and fruit infection early in June. The practice of spraying three weeks after petal fall did not give satisfactory results, but the 'two weeks' and possibly the 'ten day' applications were apparently beneficial. The results of observations available at the time of writing indicate that in 1923 infection started late rather than early, possibly on account of the abnormally dry and slightly late spring.

Black rot or frog-eye of apple [*Physalospora cydoniae*] was very well controlled by the use of fungicidal dusts, which are not, however, equal to commercial lime-sulphur. This season concludes five years of work on frog-eye, the incidence of which has been very greatly reduced. Attempts to reproduce the disease by artificial inoculation failed.

Continued experiments in the control of lettuce drop (*Sclerotinia libertiana*) with formaldehyde have given uniformly satisfactory results, especially when applied to the soil in cold frames. Not less than 4 pints of commercial formalin per 50 sq. ft. of surface should be used, and two-thirds of a gallon of water per sq. ft. Complete control of the various *Sclerotinia* spp. is practicable by this method, while *Botrytis* infection may be greatly reduced, especially with lettuce transplanted from a sterilized seed-bed. Rotation has proved valuable in reducing the losses caused by *S. libertiana* and *Botrytis* in the lettuce, carrot, and celery crops, but is less effective against *S. minor*. Attempts to kill the sclerotia of *S. libertiana* in sand cultures with copper sulphate, ferrous sulphate, ferric chloride, barium chloride, chlorinated lime, sulphur, potassium permanganate, potassium sulphide, wood alcohol, crude cresol, and corrosive sublimate, gave negative results. Bordeaux mixture (1 gall. per sq. ft.) also failed to control drop in the field. Du Pont semesan (0·5 oz. per gall. water) killed all the sclerotia in an area of one sq. ft. The effect of this substance on lettuce and other seedlings has not been determined.

Thirty-fifth Annual Report of the Georgia Agricultural Experiment Station for 1922, 30 pp., 6 figs., 1923. [Received 1924.]

Among the items of phytopathological interest not already noticed in this *Review*, the following are contained in the Report.

The season of 1921–22 proved very favourable to the development of leaf rust of wheat (*Puccinia triticina*), from which only one variety (Georgia 278) appeared immune. This variety was also resistant to anthracnose (*Colletotrichum cereale*). On Khapli emmer, Kanred, and Kansas P 1066 and 1068 there was only 10 per cent. of infection. These varieties seem to be more valuable for breeding than for commercial purposes. Georgia No. P 4 (believed to be a Fulcaster selection) gave a number of highly resistant plants.

All varieties of oats were badly infected by crown rust (*Puccinia coronata*) [*P. lolii*], Appler, Red Rustproof, and Georgia Bancroft being the most resistant. Strains of Culberson and Virginia Grey Winter were almost totally destroyed.

Rosen rye showed great susceptibility to rust [*Puccinia dispersa*], and gave very poor yields.

Studies are in progress on the inheritance of resistance to tomato wilt [*Fusarium lycopersici*] and on the longevity of the fungus in soil under various treatments.

Experiments have shown that *Sclerotium rolfsii* thrives in acid media. The addition to beef broth of a small quantity of sodium hydroxide arrests all growth. Preliminary pot tests indicate a similar behaviour in the soil. Promising results have been obtained in selection experiments with a view to procuring a strain of Sumatra tobacco resistant to *Thielavia basicola*.

HORNE (W. T.), ESSIG (E. O.), & HERMS (W. B.). **Plant disease and pest control.**—*California Agric. Exper. Stat. Circ.* 265, 96 pp., 1923. [Received 1924.]

This valuable compilation is divided into four parts. The first comprises a brief description of the symptoms, causes, and control of the chief fungous diseases and insect pests of the more important economic and ornamental plants grown in California. The second part, headed 'General Subjects', contains useful information on such fungous and insect parasites as attack a wide range of plants, e.g. *Armillaria mellea*, crown gall (*Bacterium tumefaciens*), damping-off (*Pythium de Baryanum*), and various physiological troubles. Part 3 is devoted to the control of domestic pests, while in Part 4 is given a number of formulae for the standard fungicides, insecticides, and spreaders, together with information on soil disinfection and the like.

SNELL (K.). **Beiträge zur Kenntnis der pilzparasitären Krankheiten von Kulturpflanzen in Aegypten und ihrer Bekämpfung.** [Contributions to a knowledge of parasitic fungous diseases of cultivated plants in Egypt and their control.]—*Angew. Bot.*, v, 3, pp. 121–131, 1923.

The following observations, made during the author's connexion with the Bahtim (Cairo) Agricultural Experiment Station, date from a period beginning three years before the outbreak of war.

Sore shin of cotton [*Rhizoctonia solani*] causes much damage to young seedlings sown prematurely at the end of February or beginning of March. The causal organism can readily be isolated from diseased material, but the absence of fructifications is considered to render its identity doubtful. In the writer's experience attempts to control the disease by immersing the seed in naphthalene or lime have not given encouraging results, and he therefore advises strict attention to cultural measures, including thorough tillage and irrigation of the soil, followed by sowing at the rate of 8 to 10 seeds per hole.

Wilt disease of cotton (*Fusarium vasinfectum*) is seldom observed in Egypt. The author noticed it on a small scale in 1912 in Garbije, and found that the morphological characters of the fungus isolated from diseased stalks agreed with those described by E. F. Smith (*U.S. Dept. of Agric. Div. Veg. Phys. & Path. Bull.* 17, 1899). It is stated to have caused severe damage in the experimental cotton fields on the Dardanelles, and the Turkish Ministry of Agriculture has issued a circular dealing with measures for its control.

Bersim (*Trifolium alexandrinum*) was severely and extensively damaged by stem rot (*Sclerotinia trifoliorum*) on the experiment farm at Bahtim. The disease was found to be constantly associated with early sowing of the seed, the fungus being unable to develop unless it can attack the young plants during October and November. Clover should therefore not be sown on infested soil before the beginning of December.

Sesame plants [*Sesamum indicum*] submitted for inspection were found to be attacked by a wilt disease resembling that of cotton, and likewise due to *F. vasinfectum*.

Safflower (*Carthamus tinctorius*) leaves were attacked by *Puccinia carthami*, the morphological characters of which are briefly described.

The following three fungi, collected by the author in Egypt, were described by Reichert ('Die Pilzflora Aegyptens', *Engler's Jahrb.*, lvi, 5, 1921) as new species.

Sporodesmium longipedicellatum was found in leaf spots on cotton leaves. The brownish conidia are sub-clavate, the base merging into the stalk, and the walls constricted at the septa. The stalk is long, hyaline, non-septate, and is limp at the base, collapsing with the conidium.

Macrosporium oleae forms a whitish-grey coating on olive leaves. The hyaline (later brownish), septate hyphae grow in convolutions close to the epidermis, and the oval conidia are borne on long conidiophores.

Cercospora snelliana forms a thick layer on the under side of the leaves of *Morus alba*. The numerous brown conidiophores, occurring singly and in bundles, are septate and simple. The spores are hyaline, unicellular, and elliptical when young, then olive-brown and with 3 to 7 septa.

Bunting (R. H.). **Mycological notes.**—*Journ. Gold Coast Agric. & Comm. Soc.*, ii, 3–4, pp. 163–165, 1923.

The causal organism of the mealy pod disease of cacao and coffee,

Trachysphaera fructigena [see this *Review*, ii, p. 497], which was formerly believed to confine its attacks to the fruit, was recently found on young shoots of *Coffea liberica* previously weakened by insects. It has also been found as a wound parasite on the avocado pear. So far the fungus has not been recorded on any indigenous host.

Collar crack of cacao [see this *Review*, ii, p. 210] has been found to be due to a species of *Armillaria* closely resembling, if not identical with, *A. mellea*. The description of the disease first published was based on specimens of the fruiting bodies in a decayed condition, and therefore requires some modification. Probably the best characteristics for easy identification are the development of the fruiting bodies (toadstools) in clumps, the height varying from ¼ to 3 ins., the gills being yellowish-white, and the caps brown and scaly; there is a yellowish-white connexion between cap and stem, and the latter is white at the top and dingy brown to black and rough at the base.

BLARINGHEM (L.). **Notes sur la biologie des rouilles et des charbons. II.—La rouille noire (Puccinia graminis Pers.) au printemps de 1923 à Bellevue (S.-et-O.), sur les Blés résistants et sur leurs hybrides.** [Notes on the biology of rusts and smuts. II. Black rust (*Puccinia graminis* Pers.) on resistant Wheats and their hybrids, at Bellevue (S.-et-O.), in the spring of 1923.]—*Rev. Path. Vég. et Ent. Agric.*, x, 3, pp. 225–234, 1923.

The author's investigations at Bellevue, near Paris, on the behaviour of pure line strains of *Triticum sphaerococcum*, *T. monococcum*, and *T. vulgare* in regard to *Puccinia graminis* have revealed widely differing degrees of resistance within the same species, grown under varying climatic conditions. Thus, strains of the first-named species, received from Algeria and other Mediterranean districts developed a maximum of rust at Bellevue in 1923, while closely similar strains obtained from intermediate localities, where some sort of acclimatization had evidently taken place, showed marked resistance. A strain of *T. monococcum* from north Africa was susceptible, while other strains from Paris were practically immune. The same phenomenon was observed previously by the author in the case of certain Svalöf varieties of *T. vulgare* which succumbed to *P. glumarum* when grown at Bellevue directly from Swedish seed, and showed resistance when the seed was grown for some years in Württemberg before being brought to Paris.

The behaviour of various hybrids from species of *Triticum* crossed with the highly resistant *T. monococcum* lines is described. The cross *T. monococcum* II × *T. dicoccum*, of which the latter is susceptible to black rust, gives a hybrid which is very susceptible in the first generation, while the hybrid *T. diccocoides* × *T. monococcum* II remained immune in the F_1. *T. monococcum* × *T. durum* is more susceptible to *P. graminis* than either of the parents, and it is thought that the greater vital activity revealed in the large yield of this hybrid also favours the development of the fungus. The combination *T. monococcum* II × (*T. monococcum* × *T. durum*)

produces very slender plants covered with rust pustules, which show a greater degree of development than is generally seen on the hybrid *T. monococcum* × *T. durum*. The results obtained from the reverse combination (*T. mono.* × *T. dur.*) × *T. monococcum* II are similar, though the plants are more vigorous. (*T. mono.* × *T. dur.*) × *T. turgidum* (Bourdon 6) inherits the susceptibility of the male parent, which is considerable. (*T. mono.* × *T. dur.*) × *T. diococcum* (? Blé du Maroc 1), of which the latter is fairly resistant, is much more susceptible than either of the parents. In the hybrid *T. polonicum* × (*T. mono.* × *T. dur.*), the female parent in which is very susceptible to *P. graminis*, susceptibility is intermediate between that of the parents. This seems to be the only exception to the rule that interspecific hybrids of *Triticum* generally show greater susceptibility to rust than the parents. As this increase in susceptibility seems to be correlated usually with the greater vegetative vigour displayed by them (at least in the first generation), the exceptional behaviour of the hybrid from *T. polonicum* may be due to the fact that this combination produces plants with a less pronounced vigour of growth and reduced foliage.

Peltier (G. L.). **A study of the environmental conditions influencing the development of stem rust in the absence of an alternate host. II. Infection studies with Puccinia graminis tritici Form III and Form IX.**—*Nebraska Agric. Exper. Stat. Res. Bull.* 25, 52 pp., 12 pl., 1923. [Received 1924.]

From 1921 to 1923 a detailed study of the two biologic forms III and IX [see this *Review*, iii, p. 158] of *Puccinia graminis tritici* was carried on to determine whether or not their reaction on the differential hosts remained consistent under varying environmental factors (soil temperature, soil humidity, and air temperature). At the same time the influence of environmental factors on the growth of the host and development of the disease was noted.

In all the experiments, which were conducted in modified Wisconsin soil-temperature tanks, a relative air humidity of 95 to 100 per cent. was maintained. The same soil moisture, namely, 68·2 per cent. of the moisture-holding capacity, was maintained in all the temperature tests. The intensity and duration of the sunshine, however, varied from day to day. Little or no rust developed during the winter months when the daily duration of sunshine was short, the time of minimum growth of the host evidently coinciding with that of the parasite.

In no case was the general type of infection of a biologic form on a differential host changed by (1) any of the environmental factors to which such form and host were exposed; (2) the source of the inoculum; or (3) the source of seed of the differential hosts.

The best development of the differential hosts at the seedling, stooling, jointing, and heading stages occurred at 15° and 20° C. Temperatures of and below 10° retarded growth, while at 25° and 30° development was altogether inhibited. Generally speaking, there is a wider temperature range, especially at the higher temperatures, for the infection of seedlings by rust than of plants in the heading stage. The temperatures at which the plants make

their best growth approximately coincide with those favouring the development of the disease.

Initial infection can take place under conditions unfavourable to the development of the causal organism, which may also remain quiescent in the tissues of the host for long periods without manifesting any external symptoms. The optimum temperature for initial infection with Form III was found to be about 25°, while with Form IX it was nearer 20°. In the seedling, stooling, and jointing stages the optimum temperature for the development of the disease with both forms was between 20° and 25°. No infection occurred at or below 10°, while only a few plants of certain hosts were infected at 15° and 30°. With plants at the heading stage the optimum temperature for infection was lower, rust developing at 10° but not at 30°.

The incubation of Form IX was extended over a period of 7 to 9 weeks by submitting inoculated plants to a low temperature. The length of this period, however, depends not only on the temperature but also on the stage of development of the organism in the leaf tissues of the host.

The fact that a host is readily penetrated by the parasite does not necessarily mean that it will prove susceptible. Thus a higher percentage of penetrations (initial infections) was obtained with the resistant Khapli than with any of the susceptible hosts. The real test of resistance occurs after the fungus passes through the stomata of the host.

Beauverie (J.). **La rouille jaune du Blé (Puccinia glumarum).** [The yellow rust of wheat (*Puccinia glumarum*).]—*Comptes rendus Acad. des Sciences*, clxxvii, 20, pp. 969–971, 1923.

The year 1923 was marked in the province of Auvergne (France) by a violent epidemic of yellow rust of wheat (*Puccinia glumarum*) which lasted throughout the vegetative period. *P. triticina* and particularly *P. graminis*, on the other hand, were not prevalent and only appeared towards the middle of July. Meteorological conditions were very favourable for the development of the disease. Both in October 1922 and in April 1923 the rainfall was abnormally high (167 mm. and 76 mm. against the normal averages of 58 mm. and 50 mm. respectively) and the temperature remained very mild throughout the winter. During the 'critical period' of thirty days before the appearance of the ears and ten days after [see this *Review*, ii, p. 361], the rainfall was low, viz., from 46 to 57 mm. as against 70 to 120 mm. in the best [wheat] years. In the first eight days of May temperature was high, giving a precocious and vigorous vegetative growth and thus rendering the wheat plants very susceptible to the parasite; it then dropped considerably and remained low up to July, causing a retention of water both in the soil and in the plants. After the 10th July the temperature rose sharply, when *P. triticina* and *P. graminis* made their appearance, too late, however, to cause any appreciable damage. Under such conditions the yellow rust produced uredospores, during the whole of the summer almost without any teleutospores, while the two other rusts completed their development much more rapidly and produced both forms of spores almost simultaneously. The epidemic

of yellow rust was at its highest in May; the most susceptible varieties of wheat, especially Bon Fermier, were yellow from top to bottom, and the soil also was covered with a yellow layer of spores.

According to the author's observations on the reaction to the rust of over 200 varieties and 1800 strains of wheat, precocity of development appears to play a considerable part in varietal susceptibility to the yellow rust [see also this *Review*, iii, p. 209]. Late varieties escape early infection and are only attacked if weather conditions are favourable to the disease at the period when they attain the susceptible stage of development, but they are more liable to infection by the other two rusts. This complicates the problem of selection of wheat strains for rust resistance. Some varieties appeared, however, to possess similar degrees of susceptibility or resistance during all the stages of growth, Bon Fermier being among the most susceptible, and Hybride de la Paix appearing to be highly resistant throughout.

SCHAFER (E. G.). **Division of Farm Crops.**—*Thirty-third Ann. Rept. Washington Agric. Exper. Stat. for the fiscal year ended June 30, 1923*, pp. 29–32, 1923. [Received 1924.]

Work is in progress on bunt and smut resistance in wheat and oats and many promising immune strains have been isolated from the various crosses. Plants selected from susceptible F_3 rows remained susceptible in the F_4 generation. Bunt (*Tilletia tritici*), after passing one generation on rye, affected wheat without any apparent loss of vigour.

The lemma of common oats was found to afford marked protection from the attacks of covered smut [*Ustilago levis*], infection being practically doubled on its removal. Copper carbonate effectually controlled this disease, and proved equal to copper sulphate in its effect on *T. tritici*.

A hundred F_2 rows of rye × wheat all resembled rye but distinctly showed their hybrid origin. *T. tritici* appeared in 42 of the rows, one of which contained 10 per cent. of infected heads.

An F_3 family of Red Rustproof × Abundance oats produced types both earlier and later than either parent; 83 per cent. of the 345 rows were immune from covered smut (like Red Rustproof), while only 1 per cent. were as susceptible as Abundance.

NEILL (J. C.). **Stinking smut of Wheat. I. The effect on germination of some seed disinfectants.**—*New Zealand Journ. of Agric.*, xxvii, 3, pp. 159–166, 1923.

Tests of different methods for the control of bunt (*Tilletia tritici* and *T. levis*), which is stated to be the most formidable enemy of wheat in New Zealand, are described.

Tables are given showing the germination percentage at 3, 6, 10, and 14 days for each of the treatments, namely, dusting with copper carbonate $\frac{1}{2}$, 1, 2, and 3 oz. per bushel; dusting with anhydrous copper sulphate and calcium carbonate in equal parts 1, 2, 3, and 4 oz. per bushel; steeping in copper sulphate solution 1 lb. in 10 galls. and 1 lb. in 5 galls., each strength being tested with and without presoaking, with and without rinsing; and steeping in

formalin 1 pint in 40 galls. similarly with and without presoaking and rinsing.

It is pointed out that in field practice the percentage of germination at 3 and 6 days is the important factor in the future development of the stand. It is improbable that many of the seedlings, germinating after the sixth day would develop into grain-producing plants.

In all the tests some of the seed was placed in the germinators 1, 14, and 28 days after treatment. In the first case neither of the dust treatments caused any appreciable reduction in germination as compared with the controls. [Full details of the germination figures are given in all cases.] The copper sulphate dip, however, caused a decided reduction, most marked with the stronger solutions and in the 3- and 6-day figures. Formalin caused relatively little injury. In the second series (seed placed in germinators 14 days after treatment) the results were in general similar. In the third series the delay of 28 days after treatment increased the copper sulphate injury and also caused an appreciable reduction in germination after the formalin dip without presoaking. The dusts gave results only slightly below the controls, even in the 3- and 6-day tests.

In general, washing after treatment with copper sulphate reduced the injury while presoaking increased it. The effect of the formalin dip varied according to the three wheat varieties tested, Pearl being uninjured even after 28 days' delay in sowing, while College Hunters and Purple-straw Tuscan were somewhat injured even when tested after 1 day. Formalin injury was reduced by washing and almost entirely prevented by presoaking.

LANG (W.). **Gerstenhartbrand.** [Covered smut of Barley.]—*Nachrichtenbl. deutsch. Pflanzenschutzdienst,* iii, 9, pp. 67–68, 1923.

For the last ten years the writer has unsuccessfully endeavoured to secure infection with the covered smut of barley (*Ustilago hordei*), whether by sowing seed from an infected crop or by the use of artificially smutted grain. The resulting harvests were either quite healthy or slightly infected by loose smut (*U. nuda*). After repeated failures, germination experiments were carried out with the spores from ears of barley apparently attacked by covered smut with the result that the long germ-tubes without sporidia of *U. nuda* were produced. It seems probable, therefore, that a large proportion of the supposed cases of covered smut are really due to loose smut. The incomplete destruction of the ear in such cases is accounted for by the incapacity of the fungus to keep pace, under certain conditions, with the rapid development of the inflorescence, so that the former is still making its way through the ovary during the growth of the glumes. In external symptoms, therefore, the plants attacked in this way resemble those infected with covered smut.

The rapid development of the ears is dependent mainly on temperature, but also on the composition of the soil, being favoured by poor light soils. This corresponds with the reported incidence of *U. hordei*, which is stated to occur principally on the light soils of

North Germany. Only two cases of supposed attack by covered smut have been observed by the author in the rapidly drying soils of the Alb region (Württemberg) and both were subsequently found to be due to *U. nuda*. According to Schellenberg, covered smut is primarily a native of the Swiss Alps and loose smut of the plains.

The author points out that it is of great practical and scientific interest to ascertain the exact rôle of the two species of *Ustilago* in the so-called covered smut of barley.

TISDALE (W. H.). **An effective method of inoculating Barley with covered smut.**—*Phytopath.*, xiii, 12, pp. 551–554, 1923.

Experiments were conducted in 1921 and 1922 at Rosslyn, Virginia, to test the accuracy of the general opinion that hull-less barley and oats are more liable to smut than varieties with glumes closely adhering to the seed. It was found that barley was much more subject to infection by covered smut (*Ustilago hordei*) if the hulls were removed before inoculation. Thus dehulled seed of Tennessee winter barley showed 85·03 per cent. of infection, compared with 3·97 per cent. on hulled seed. Similar results were obtained with 11 other varieties. There was some indication of difference in varietal susceptibility, Nakano Wase remaining immune from infection under all conditions. It would appear that the spores which produce infection are carried between the hull and the kernel.

The hulls are believed to be the main obstacle to successful inoculation, which constitutes an essential feature of testing for resistance, and it is important that a more efficient means of dehulling should be found.

MACKIE (W. W.). **Foot-rot or Ophiobolus in California.**—*Phytopath.*, xiii, 12, pp. 561–562, 1923.

The occurrence of foot-rot (*Ophiobolus graminis*) [*O. cariceti*] at Davis, California, is now definitely recorded after several years of uncertainty, the perithecia of the fungus having been found on wheat and barley. The disease, which appears to be widespread and of long standing, is particularly prevalent on the Hard and White Federation varieties of wheat.

MCKINNEY (H. H.). **Influence of soil temperature and moisture on infection of Wheat seedlings by Helminthosporium sativum.**—*Journ. Agric. Res.*, xxvi, 5, pp. 195–217, 3 pl. (1 col.), 6 graphs, 1923. [Received 1924.]

Controlled greenhouse and field experiments were conducted to ascertain the influence of soil temperature and soil moisture on infection of the subterranean parts of winter and spring wheat and barley plants by *Helminthosporium sativum*. Fourteen constant and one alternating soil temperature experiments were carried out in the Wisconsin soil-temperature tanks. Three soil-moisture experiments were made in the greenhouse, one in conjunction with a soil-temperature series. Two field experiments were conducted in naturally infested soil in Illinois. The results of all the experiments showed that the disease is influenced by both the factors studied. Infection developed at all temperatures between 8° and

35° C., but was greatly reduced towards the extremes. The optimum soil temperature for the development of the disease was found to be 28° on Hanna and Hannchen (spring) barleys and 32° on Harvest Queen (winter) wheat. Owing to a certain irregularity, which it is hoped to remedy in future investigations, in the control of various factors in the experiments, the determination of the high temperature optima was slightly inaccurate. At temperatures below 16° barley was more freely attacked than wheat, the most susceptible variety of which was found in all the tests to be Marquis.

In the experiment on the comparative influence of controlled alternating soil temperatures and a constant temperature it was found that essentially the same amount of disease developed when the temperature fluctuated between 14° and 30° every twelve hours as when it remained constant at 22° C.

High soil moistures (55·5 to 77·7 per cent. of the moisture-holding capacity) were shown to favour the disease, especially at the higher temperatures. The results of the combined soil moisture and temperature experiment indicate that the temperature optimum is not altered by changes in soil moisture, whereas alterations in soil temperature appear to cause a regular shifting of the soil-moisture optimum. Temperatures of 24° and above favour a high moisture optimum, and temperatures below this figure a lower one.

The field experiments demonstrated a direct correlation between soil temperature and moisture and the development of the disease, early sown winter wheat being more severely affected than that sown later. These results agree exactly with those of the laboratory tests, since early sowings are exposed to higher temperatures than later ones.

Mackie (W. W.) & Paxton (G. E.). **A new disease of cultivated Barley in California caused by Helminthosporium californicum n. sp.**—*Phytopath.*, xiii, 12, p. 562, 1923.

An undescribed species of *Helminthosporium* has been observed to be widely distributed on cultivated barley in California, causing a disease known as 'rusty blotch', which is most prevalent in dry, warm weather. The apices of the lower leaves are first attacked, the brown to bluish-black spots merging into a diffused brownish discoloration of the major part of the leaf.

The causal organism, which has been named *H. californicum* n. sp., resembles *H. sativum*, except in its later occurrence, greater severity, and the indefinite character of the affected areas. The conidia are longer and wider (average 58 by 22 μ) and also more dense and thicker-walled than those of *H. sativum*, and are not curved.

Lee (H. A.). **California scaly bark and bark rot of Citrus trees in the Philippines.**—*Philipp. Agric. Rev.*, xvi, 3, pp. 219–225, 8 pl., 1923.

Two diseases are stated to be largely responsible for the continuous decline of the formerly prosperous citrus, chiefly sweet orange (*Citrus sinensis*), industry in Batangas Province, Philippine Islands.

Psorosis or scaly bark [see this *Review*, ii, p. 542] agrees in the

main with the Californian form of the disease. Under Philippine conditions, however, the eruptions are somewhat larger and infection extends longitudinally as well as laterally. Pomelo and grape-fruit trees are also somewhat liable to psorosis. No varietal resistance of sweet orange trees has been observed. The cause of the disease, which is believed to be infectious, is not known. In South China, where psorosis, like its host, probably originated, its ravages limit the duration of bearing in sweet orange orchards to an average of ten years at most. In Japan it occurs on the daidai (a variety of *Citrus aurantium*) and has also been observed by the writer in Guam and the Hawaiian Islands. This is believed to be the first record of its occurrence in the Philippines, China, and Japan.

Bark rot, also thought to be indigenous to South China, causes very severe injury to mandarin oranges (*Citrus nobilis* var. *deliciosa*) in the Philippines, and slightly damages the Satsuma (*C. nobilis* var. *unshiu*), the cabuyao (*C. hystrix*), the calamondin (*C. mitis*), and possibly the lemon (*C. limonia*). The most noticeable symptom of the disease, which also occurs in Japan, is the exudation of white foam from longitudinal cracks in the bark. A fungus of the *Hormiactis* type, and certain insects which are found in the exudation, are regarded as secondary agents, the primary feature of the disease being a solution of the soft, actively functioning bark cells. Bark rot differs from the *Diplodia* gumming disease (*D. natalensis*) in the presence of the characteristic white exudate, in the position of the lesions, and in the host most severely attacked, *Diplodia* not having been observed on mandarins.

While there are some indications that these diseases may be prevented by spraying, it is believed that the best and cheapest way to prevent more serious losses from them is to adopt stringent quarantine measures for their exclusion from countries in which they are not yet known to occur. Psorosis is apparently unknown in Java, and bark rot in California, Florida, Java, and South Africa.

RYERSON (K.). **Efficiency in scaly bark and shell bark control.**—*California Citrograph*, viii, 11, pp. 371, 401, 6 figs., 1923.

Recent experiments carried out in Los Angeles County, California, in the control of scaly bark or psorosis of the orange [see preceding abstract] showed that a very dilute Bordeaux wash may be substituted for Bordeaux paste in cases where fumigation is likely to follow at an early date. The wash is much safer than the paste under these conditions, the latter frequently resulting in severe injury to the trees. Corrosive sublimate 1 in 1,000 and mercuric cyanide 1 in 500 are also effective. Carbolineum gives very satisfactory control, but surfaces so treated should be whitewashed to prevent sunburn. Another mild fungicidal covering which has been found very useful consists of one part of sulphur to four parts of lime.

Shell bark of lemons [see this *Review*, ii, pp. 66, 393] like scaly bark, may be controlled by scraping and the application of one of the above-mentioned disinfectants. Very satisfactory control of the disease was secured by treatment with corrosive sublimate, followed by painting with Bordeaux paste or Oronite paint, but

provided the scraping is well done the choice of the disinfectant appears to matter little.

POPE (W. T.). **The acid Lime fruit in Hawaii.**—*Hawaii Agric. Exper. Stat. Bull.* 49, 20 pp., 6 pl., 1923.

The acid lime (*Citrus aurantifolia*), which is extremely well adapted to Hawaiian conditions, is stated (pp. 12–13) to be subject to the following fungous diseases: blue mould (*Penicillium italicum*), the spores of which lodge on the fruit in the orchard and germinate when the skin is injured during picking; brown rot (*Pythiacystis citrophthora*), which causes a brown discoloration and internal decay of the fruit; and anthracnose (*Gloeosporium limetticolum*), recently identified in Hawaii, which produces spotting and premature fall of the leaves, but has not yet proved serious in the Territory. Directions are given for the control of these diseases by spraying with Bordeaux mixture.

CARNE (W. M.). **The occurrence of blue mould on Citrus fruits.**—*Western Australia Dept. of Agric. Leaflet* 114, 3 pp., 1923. [Received 1924.]

The occurrence of blue mould (*Penicillium* spp.) on stored citrus fruit from the south-west of Australia is responsible for heavy losses. Consignments to England in 1923 are stated to have developed 25 or more rotten fruits per case, resulting in very unprofitable returns. The most frequent cause of infection is the careless handling of fruit; oranges in particular require the most delicate manipulation. All injured, bruised, or fallen fruit, should be rejected for export purposes. The fruit should be sweated on open benches in a well-ventilated shed, wrapped, and packed in a dry condition, in standard flat bushel cases ($26 \times 14\frac{1}{4} \times 6$ inches).

BARTHOLOMEW (E. T.). **Alternaria rot of Lemons.**—*California Citrograph*, viii, 8, pp. 262, 294–295, 2 figs., 1923.

Arising out of investigations on the internal decline of lemons [see this *Review*, ii, p. 407] a study has been made of the *Alternaria* rot, also known as 'centre' or 'black rot', of this fruit. The disease, which is frequently associated, though not directly connected, with the final stages of internal decline, occurs in packing-houses and during transit, sometimes in conjunction with *Colletotrichum* [*gloeosporioides*].

Inoculation experiments on silver and green lemons showed that painting a suspension of *Alternaria* spores on to the 'buttons' and adjoining rinds only slightly increased the amount of decay, which occurred also in inoculated fruit sterilized with copper sulphate, and in the controls, which were washed with water only. The treated fruit was placed in a thermostat apparatus at temperatures ranging from 48° to 97° F. After $3\frac{1}{2}$ months it was found that, even in the superficially healthy fruit, the *Alternaria* was working its way down into the tissue, sometimes to a depth of 2 to 3 cm. beneath the button, especially at the higher temperatures.

The silver varieties were more susceptible than the greens, and the optimum temperature for the development of the fungus was

found to be about 79°, with a minimum and maximum of 48° and 94° respectively.

The results of tests on the efficacy of different sterilizing solutions in preventing *Alternaria* rot showed that a hot solution (118°) of corrosive sublimate (1 in 1,000) considerably retards, without absolutely checking, the development of the disease.

The fungus was present in 47·7 per cent. of the small stems by which the lemons are attached to the twigs. It appeared first in the small bracts, through the dying cells of which it readily obtained admission. Similar data were obtained in connexion with young oranges. These facts are regarded as significant in view of their possible bearing on the 'June drop' problem.

PUTTERILL (V. A.). **Plant Diseases in the Western Cape Province. XI.**—*Journ. Dept. of Agric. S. Africa*, vii, 5, pp. 403–406, 4 figs., 1923.

The first part of this paper records an isolated instance of severe internal gumming of the fruit from some bitter seville orange trees in the Stellenbosch District. There were no external symptoms of the disease, which caused large discoloured regions in the tissues of the fruit. No causal organism was found in the affected tissues, and it is thought that the trouble must be traced to the unsuitable climatic conditions prevailing during the summer and autumn, as later fruits on the same trees were in every way normal.

In the Mario District, Transvaal, rough greyish patches on the surface of the skin of oranges, in some cases slight, in others covering practically half the surface, were traced to a fungus which forms irregular chains and clamps of brownish spores and which appears to be identical with *Coniothecium scabrum* McAlpine. The disease in Australia is called black scurf and the same name is proposed for South Africa. The injury, which resembles that caused by thrips, is only superficial, and although it cannot be termed serious, the trouble cannot fail to cause loss to the growers on account of the unsightliness of the fruits. Spraying with a fungicide should give effective control.

SUNDARARAMAN (S.). **Fungus on caterpillars damaging Indigo plants in the Rubber Station, Mooply.**—*Planters' Chron.*, xviii, 39, p. 586, 1923.

Dead caterpillars on damaged indigo plants from the Mooply Rubber Station, South India, were found to be covered with a white, flocculent mass of mycelium, which in a few cases bore clusters of minute spores at the tips of verticillate branches. In glucose agar cultures the mycelium developed profusely and spores were formed only at the later stages, while on agar without glucose spore formation predominated.

Live caterpillars from indigo being unobtainable, inoculation experiments were carried out on caterpillars attacking ragi plants [*Eleusine coracana*]. In the two experiments described the caterpillars were killed in 5 and 6 days respectively and were covered with the fungus, while the control insects remained healthy.

Petch (T.). **The genus Trichosterigma Petch.**—*Trans. Brit. Mycol. Soc.*, ix, 1–2, pp. 93–94, 1923.

The author states that the new genus of Stilbaceae, *Trichosterigma*, proposed by him in 1922 to include three species of fungi parasitic on insects, is synonymous with the genus *Hirsutella* established in 1892 by Patouillard on a species, *H. entomophila*, which was found on an undetermined coleopteron in Ecuador. Patouillard regarded the fungus as a Basidiomycete and included it in the Clavariaceae. In 1912 Speare published an account of the fungi parasitic on insects injurious to sugar-cane in Hawaii in which he described and figured, under the heading 'Sterile *Cordyceps*', a conidial fungus parasitic on a leaf hopper; subsequently he further studied this and other similar fungi and came to the conclusion that they should be included in the genus *Hirsutella* Pat. There does not appear to be any doubt that this conclusion is correct, and that *H. entomophila*, the type species of the genus, is a Hyphomycete.

Of the species described by the author (*Trans. Brit. Mycol. Soc.* viii, p. 215), *Trichosterigma attenuatum* Petch = *Hirsutella citriformis* Speare, while *T. clavisporum* Petch and *T. arachnophila* Petch must be known as *H. clavispora* and *H. arachnophila* respectively.

Isaria saussurei Cooke, parasitic on hornets in the tropics, was found by Speare in Hawaii, California, and the West Indies to be a *Hirsutella*, for which he adopted the name *H. saussurei*. The corresponding Ceylon form is also a *Hirsutella* and apparently the same species.

No ascigerous stage has hitherto been recorded for any species of *Hirsutella*, but Speare's surmise that these forms are probably imperfect stages of *Cordyceps* or an allied type is correct, as during a recent examination of Ceylon species of *Cordyceps* it was found that *C. unilateralis* has a *Hirsutella* conidial stage, the apex of the clava being at first conidial. Further, *H. arachnophila* has been found in association with a *Torrubiella*, and though the two have not been found together on the same stroma, there is little doubt that both are stages of the same fungus.

Goldstein (Bessie). **Resting spores of Empusa muscae.**—*Bull. Torrey Bot. Club*, l, 10, pp. 317–327, 1923.

Since 1921 the author has had under observation large numbers of the common fly (*Musca domestica*) attacked by the fungus *Empusa muscae*. Sections of dried flies revealed the presence of multinucleate, rounded, thick-walled resting spores in the abdomen. Probably Brefeld and most other investigators failed to find any trace of resting spores on account of their late development, though they were mentioned by Winter in 1881.

The resting spores are believed to be chlamydospores, formed under dry conditions when conidial discharge is no longer possible. They are generally developed as terminal swellings on short hyphal fragments or tubes, or intercalary in the hyphal filaments, or by apparent budding from hyphal bodies. Evidence is adduced to prove that the spores are totally distinct from those of *Entomo-*

phthora americana or any of the other entomophthorous forms occurring in the house fly.

VINCENS (F.). **Sur l'Aspergillomycose des Abeilles.** [On the Aspergillomycosis of Bees.]—*Comptes Rendus Acad. des Sciences*, clxxvii, 12, pp. 540–542, 1923.

The author records the discovery in the Alpes Maritimes [southern France] of a disease of bees previously reported only from Central Europe. A very brief description is given of the affection, which is due to a species of *Aspergillus* closely related to *A. flavus* Link. The fungus is very variable in its morphological characters, especially in a tendency to develop abundant fructifications closely resembling those of *Spicaria*. Isolations from bees characteristically mummified by the infection invariably gave rise only to this fungus, and the author succeeded in reproducing the disease in adult bees by feeding them with honey containing its spores, the death-rate in the inoculated cases being up to 100 per cent. The virulence of the fungus appears to depend on the morphological strain of the organism, on the temperature at which the infected bees are kept, and on the concentration of the syrup with which they are fed. Death appears to be due both to a mechanical stoppage of the digestive canal with the mycelium and to paralysis of the intestinal muscles.

The disease is not thought likely to spread seriously in France, as it can easily be checked by simple hygienic precautions. It is possible, however, that the fungus may be the cause of one of the spring diseases which annually attack bees and are known to produce symptoms which are strikingly like those observed by the author in his experiments.

MEHTA (K. C.). **On the mode of infection and perennation of the smut of 'Doob' (Cynodon dactylon Pers.).**—*Journ. Ind. Bot. Soc.*, iii, 9–10, pp. 243–251, 5 figs., 1923.

The author's inoculation experiments with *Ustilago cynodontis* on 'doob' [Bermuda grass] (*Cynodon dactylon*), an important fodder grass which is subject to considerable damage from smut, showed that infection takes place in the earlier stages of the germination of the seed, which ceases to be susceptible probably within three or four days after its sprouting. Negative results were obtained from seven trials of blossom inoculation.

It was shown by experiments that when diseased plants were transplanted they gave only smutted inflorescences, while healthy plants similarly treated remained healthy. The rhizomes as well as the aerial shoots of diseased plants were permeated by hyphae. The perpetuation of the disease depends, therefore, much less on fresh seedling infection than on the presence of mycelium in the rhizomes and shoots which are generally used, instead of seeds, for the propagation of this grass.

YOUNG (W. J.). **Clover root rots and powdery mildew.**—*Ohio Agric. Exper. Stat. Monthly Bull.*, viii, 9–10, pp. 157–160, 1 fig., 1923.

Root rot or wilt of clover may be due to two distinct causes,

namely, *Sclerotinia trifoliorum*, and a species of *Fusarium* the cultural characteristics of which resemble those of *Gibberella saubinetii.* The first type is found in the north-west of Ohio, where it occasionally proves destructive in wet seasons, but the second form of the disease is more frequent and widespread. The symptoms of both types of wilt are briefly described. The roots decayed by *Fusarium* are firmer and drier than those attacked by *Sclerotinia* and the sclerotia of the latter are characteristic. If, as appears probable, the *Fusarium* associated with clover wilt is identical with the maize root rot and wheat scab organism, clover may become directly infected from one of these cereals. The spores are known to persist in the soil for a considerable period and the temporary substitution of a non-susceptible leguminous crop, such as soy-beans, for clover is probably the best means of eradicating the fungus.

Powdery mildew (*Erysiphe polygoni*) does not, as a rule, cause very severe damage unless it becomes established early in the season. It is apt, however, to weaken the resistance of the plants and render them susceptible to root rot in the following spring.

Common or medium red clover is very susceptible to both forms of wilt and to mildew. Mammoth appears to be more resistant to wilt, while alsike is immune from *Sclerotinia* and only slightly susceptible to *Fusarium* wilt. Both alsike clover and lucerne are highly resistant to mildew, but the latter is occasionally attacked by both forms of wilt. Sweet clover [*Melilotus alba*] appears to be almost immune from all three diseases.

ADAMS (J. F.). **Diseases of fruit and nut crops in the United States in 1922.**—*Plant Disease Bull. Supplement* 28, pp. 268–392, 9 maps, 1923. [Received 1924.]

This report has been prepared on the same general lines as previous ones of a similar nature [see this *Review*, i, p. 376].

Although conditions generally were more favourable to fruit growing in 1922 than in 1921, the losses from apple scab (*Venturia inaequalis*), especially in the eastern States, were excessively high, various collaborators reporting the epidemic to be the worst experienced for many years.

Apple blotch (*Phyllosticta solitaria*) appears to be greatly on the increase, the highest losses occurring in Kentucky. In Delaware (where the disease was also very severe) the maximum amount of infection on the fruit was found during July. Evidence of the spread of the disease by infected nursery stock is accumulating. Good control is stated to have been secured by excision of cankers and spraying with lime-sulphur or Bordeaux mixture.

Spraying experiments against cedar rust (*Gymnosporangium juniperi-virginianae*) in Delaware and Missouri gave unsatisfactory results. The eradication of the alternate host has led to a reduction of the disease in West Virginia and Arkansas, but in South Carolina there appears to be no correlation between the presence of junipers and the incidence of infection.

Fireblight (*Bacillus amylovorus*) was extremely prevalent on apples in many localities, principally on the blossoms in June. The eradication of Transcendent crab-apples and other susceptible wild

hosts has been undertaken in several States. There was no evidence of insect dissemination of the disease in certain cases.

Collar rot, due to an undetermined cause, was reported on apple trees over 13 years old of the Grimes Golden variety in Ohio, Indiana, and Illinois.

Apple fruit spot (*Phoma pomi*) has increased in prevalence in Massachusetts, New Jersey, Delaware, and Ohio. It is frequently associated with sooty blotch and fly speck (*Phyllachora pomigena* and *Leptothyrium pomi*) in excessively rainy weather. Good control was generally secured by spraying.

Anthracnose (*Neofabraea malicorticis*) has greatly decreased on apples in the north-west as a result of the control campaign, one application of Bordeaux mixture before the autumn rains being sufficient.

Pears were heavily attacked by fireblight (*B. amylovorus*), especially in the south. No definite correlation could be established between the incidence of the disease on pears and the heavy infection noted on apples. The Kieffer, Sand, and certain Chinese varieties exhibited resistance to fireblight. The honey bee has been definitely implicated as a carrier [see this *Review*, ii, p. 452] but owing to its pollinating value, its exclusion from orchards should not be attempted.

Sooty blotch (*Phyllachora pomigena*) was extremely severe on pears in New York and Delaware.

Quinces were severely attacked by fireblight (*B. amylovorus*) in New York and other States. Powdery mildew (*Podosphaera oxyacantha*) was also reported on this host.

Peaches were much damaged by brown rot (*Sclerotinia cinerea*) in the Atlantic States, especially in unsprayed orchards. Peach leaf curl (*Exoascus deformans*) was fairly severe in the eastern commercial peach-growing area, especially where the dormant spray was neglected. The bacterial spot and canker of the peach caused by *Bacterium pruni* is constantly increasing in certain States and is stated to be the worst disease of this fruit in Delaware. Black mould (*Rhizopus* sp.) was responsible for very heavy losses (up to 65 per cent.) in peaches in transit.

Plums and prunes were severely attacked by brown rot (*S. cinerea*) in the Atlantic States. Bacterial spot (*Bact. pruni*) was apparently much less prevalent on plums than peaches. Among physiological diseases of plums may be mentioned a disturbance observed in Kentucky and termed 'hard flesh spots', which produces bluish depressions on the fruit, the flesh beneath the affected areas being hard and shrunken.

Grapes in the north-eastern States were heavily attacked by black rot (*Guignardia bidwellii*) while anthracnose (*Gloeosporium ampelophagum*) was reported for the first time from Minnesota. Ripe rot caused by *Melanconium fuligenum* was of local importance in Delaware. The incidence of storage and transit rots was very heavy, up to 95 per cent. infection being noted in certain consignments.

Strawberries suffered considerable damage from leaf spot (*Mycosphaerella fragariae*) in Illinois and Minnesota, while leaf scorch (*Mollisia earliana*), which overwinters in the imperfect

stage on the mulched green leaves, caused greater injury than leaf spot on certain varieties in Michigan and was very destructive in North Carolina. Root rot, due to an undetermined cause, is stated to be of considerable economic importance. Yellows, apparently of the mosaic type, is serious in Illinois and Minnesota.

The diseases of raspberry, currant, citrus, and miscellaneous fruit and nut plants, many of which have already been referred to in this *Review* from other sources, are briefly discussed. Copious notes are given throughout on the seasonal incidence and distribution of the various diseases enumerated, especially in relation to meteorological conditions; on varietal susceptibility; on control measures; and on current literature on the subject.

DARROW (G. M.). **Fruits in West Virginia, Kentucky, and Tennessee.**—*U.S. Dept. of Agric. Bull.* 1189, 81 pp., 34 figs., 1923. [Received 1924.]

This bulletin contains a number of references, embodying the results of investigations carried on since 1912, to the varietal susceptibility to fungous and other diseases of the fruits cultivated in the States mentioned.

LÜSTNER (G.). **Ueber das Auftreten des Apfelmehltaues [Podosphaera leucotricha (Ell. et Everh.) Salm.] auf Apfelfrüchten.** [The occurrence of Apple mildew [*Podosphaera leucotricha* (Ell. & Everh.) Salm.] on Apple fruit.]—*Nachrichtenbl. deutsch. Pflanzenschutzdienst*, iii, 10, pp. 74–76, 1 fig., 1923.

Apple mildew (*Podosphaera leucotricha*) is increasing in prevalence and severity both on apples and pears in Germany. The differences in varietal susceptibility are considerable, and appear to fluctuate from year to year. Thus in 1922 the Geheimrat Dr. Thiel pear was severely attacked, while in 1923 the infection on this variety was negligible.

It is difficult to establish any definite correlation between meteorological conditions and the incidence of mildew. The severe epidemic of the disease in 1923 was associated with abnormally cool, damp, and sunless weather, whereas in 1921 a similar outbreak coincided with an unusually hot and dry period. These fluctuations do not coincide with those of the vine mildew [*Uncinula necator*], the latter having been very mild in 1923 but severe in 1916, when *P. leucotricha* gave no cause for anxiety.

The activity of the hybernating mycelium in the interior of the leaf buds may readily be detected in shoots which have overwintered in the open and are then brought into a warm, damp room. The fungus is already in evidence on the unfolding leaves. In 1923 it was noticed on 26th March.

Mildew was observed, apparently for the first time in Germany, on apple fruits at Geisenheim [Rhine] on the Cox's Pomona variety at the end of June. The fruits showed more or less extensive mildewed areas, conspicuous at a distance, on the sides and stem and calyx ends. A little later mildew was observed also on the fruits of several other varieties, on most of which perithecia were already formed by the beginning of July.

It is suggested that apple mildew is not indigenous, but that its

adaptability to north European conditions is constantly increasing. Possibly it originated in North America, where its perithecial stage was first recorded.

Cunningham (G. H.). **Diplodia canker, Diplodia griffoni. A common fungous disease of the Apple.**—*New Zealand Journ. of Agric.*, xxvii, 6, pp. 380–384, 4 figs., 1923.

Diplodia griffoni, first recorded for New Zealand in 1916, has until recently been frequently confused with black rot [*Physalospora cydoniae*], but cultural work (details of which will be published elsewhere) has proved that the two diseases are quite distinct.

Diplodia canker of apples, which is second in importance to black rot in New Zealand, is prevalent on young laterals, occasionally occurring also on wood two or three years old. Girdling rapidly follows the initial attack, accompanied by a wilting and discoloration of the leaves resembling fireblight [*Bacillus amylovorus*]. The cankers are slightly depressed, reddish-brown, and zonate, while the whole surface is studded with the pycnidia of the causal organism. On older wood the elliptical, sunken cankers are generally confined to one side of the branch; they become dull brown, and in very old specimens the bark may fall away in strips. In nature the fungus has not been found on the fruit, but artificial inoculations produced a firm, brown fruit rot, and the black, raised points of the fructifications appeared on the surface.

The life-cycle of this fungus contains two spore stages, the first appearing shortly after the formation of a canker and consisting of small, flask-shaped pycnidia with large, unicellular, hyaline spores. This is the comparatively common *Macrophoma* stage. Later the spores turn dark brown, become uniseptate, and produce the somewhat rare *Diplodia* stage. In recent experiments *Macrophoma* spores were sown in certain media, and subsequently gave rise to the *Diplodia* stage.

Penetration of the tissues is apparently effected exclusively through wounds or abrasions, chiefly those caused by the woolly aphis, though careless pruning is also a fairly common source of injury. The hyphae penetrate through all the tissues, killing and discolouring them. The mycelium persists for two or more seasons, especially on older limbs, producing fructifications, under favourable conditions, the whole time. The spores are embedded in hygroscopic mucilage, which is forced out through the ostiolum as a gelatinous tendril, and is dissolved by rain. They are disseminated by wind and probably also to a great extent by insects. The fungus occurs as a saprophyte on dead apple twigs, prunings, and the like. Artificial inoculation through wounds with *Macrophoma* spores was successful on stems but not on leaves.

Remedial treatment should be based on the removal of the sources of infection and the suppression of the woolly aphis.

Brooks (C.), Cooley (J. S.), & Fisher (D. F.). **Apple scald and its control.**—*U. S. Dept. of Agric. Farmers' Bull.* 1380, 16 pp., 3 figs., 9 diag., 1923. [Received 1924.]

Susceptibility to scald, the characteristics of which are described [see this *Review*, iii, pp. 42, 215], has been found to vary greatly

with the season and with orchard conditions and management. Well coloured and properly matured apples which have been exposed to sunlight are more resistant than green fruit. Heavy applications of nitrogenous fertilizers have been found to increase susceptibility, the same being true of excessive irrigation. Low temperature (30° to 32° F.) and prompt cooling are of paramount importance in retarding the development of the trouble. Proper aeration and ventilation, especially during the first six or eight weeks of storage, are also valuable preventives. The incidence of scald has been greatly reduced by storage in hampers, ventilated barrels, or baskets, instead of tight barrels or stacks. This is particularly noticeable in experiments with Rhode Island Greening and Stayman Winesap.

It has been proved that the control of scald resulting from air circulation is not due to the oxygen supplied to the apple or the carbon dioxide removed from it; on the contrary, high percentages of carbon dioxide delay the ripening of the apple and thus decrease the incidence of the disease.

Oiled wrappers have been found to eradicate scald almost completely. In a five years' series of tests on commercial lots of apples in the East and Pacific Northwest [see this *Review*, iii, p. 215], they eliminated the disease as a market factor in all but two cases out of eighty. The disease was also controlled to some extent by placing strips of oiled blotter material between the apples.

Brooks (C.), Cooley (J. S.), & Fisher (D. F.). **Oiled wrappers, oils and waxes in the control of Apple scald.**—*Journ. Agric. Res.*, xxvi, 11, pp. 513–536, 1923. [Received 1924.]

This paper deals with the results of five years' investigations [full details of which are given] on the control of apple scald, the essential features of which have already been noticed from other sources [see this *Review*, iii, p. 215 and preceding abstract].

Morris (O. M.). **Apple rosette.**—*Washington Agric. Exper. Stat. Bull. (Tech. Paper)* 177, 30 pp., 8 figs., 1923. [Received 1924.]

Apple rosette is stated to be a prevalent disorder in most districts of Washington east of the Cascade Mountains. Rosetted trees are readily recognizable by the dense cluster of small, narrow, yellowish leaves on the ends of the twigs, the rest of which is bare. The foliage is yellowish-green or mottled, and the development of the affected and adjacent twigs is impeded. The rosette or cluster usually consists of a twig ½ to 1½ ins. in length which bears as many leaves as would ordinarily be carried by a twig 18 in. long. The affected branches may be scattered throughout the tree top or clustered on one side. Occasionally the rosettes appear as short lateral twigs attached to branches which, beyond the affected point, are making vigorous and luxuriant growth. Affected twigs frequently produce a number of short lateral spurs in the spring following a late summer attack, and die a few months later. In advanced cases diseased twigs sometimes develop approximately normal internodes with long, narrow, chlorotic leaves. Pears are also subject to the disease. No reports

have been received of any parasitic organism associated with rosette. Negative results were obtained in all experiments in the inoculation of healthy trees with diseased material.

The results of investigations carried out since 1913 indicate that the disease is related to functional or nutritional disturbances. It is particularly severe in districts with a very low atmospheric humidity during the summer or in seasons of extreme drought. Negative results followed the application of various fertilizers and manures, the excision of the affected parts, and the pruning of the normal wood. Permanent improvement, however, has frequently been secured by growing a legume cover or shade crop (preferably lucerne) for three to five years in the affected orchards.

ROOT (E. R.). **Are bees carriers of fire-blight?**—*Better Fruit*, xviii, 1, pp. 8, 26, 1923. [Received 1924.]

Referring to the prevalent belief that bees act as carriers of fireblight [*Bacillus amylovorus*: see this *Review*, ii, p. 452] the author states that, during his forty years' experience of apiculture, he has never observed an instance of transmission of infection in this way. Bees do not visit the hold-over cankers which are the principal source of infection, and there is abundant evidence that plant lice and other biting and sucking insects are the chief agents of transmission. Cases have been observed in California in which young pear trees that had never bloomed were badly blighted. Assuming, however, that bees in very rare instances do transmit infection, such slight risks are more than offset by their work of pollination which so greatly increases the quantity and improves the quality of the fruit.

CHABROLIN (C.). **Traitements contre la Cloque du Pêcher (Exoascus deformans) dans la vallée du Rhône.** [Treatment of Peach leaf curl (*Exoascus deformans*) in the Rhone Valley.]—*Rev. Path. Vég. et Ent. Agric.*, x, 3, pp. 194–201, 1923.

This is a somewhat more detailed account of the author's experiments already noticed in this *Review*, iii, p. 147.

KHAZANOFF (A.). **A new tumor of the Apricot.**—*Journ. Agric. Res.*, xxvi, 2, pp. 45–59, 13 pl., 1923.

During 1916 the author investigated a disease resulting in the formation of tumours or galls on old Moorpark apricot trees in a district of California, where it appears to have been known for at least 15 years. No serious damage has yet been observed on trees attacked by this disease, but a gradual depletion of vitality probably results. The unsightly appearance of affected trees is very striking.

The disease is readily distinguishable from crown gall (*Bacterium tumefaciens*) by the fact that the galls are bark excrescences unmixed with wood tissue; they are, moreover, unlike the bacterial galls, thoroughly permeated with gum. The most characteristic histological feature of the disease is the divergence of cork strands from their normal course on the exterior of the phloem to within the phloem tissue, sometimes almost as far as the cambium.

A species of *Monochaetia*, differing in biological and morpho-

logical characters from other species of the genus and named *M. rosenwaldia* n. sp., an English diagnosis of which is given, was isolated from the interior of the galls. Inoculated into the limbs of a healthy apricot, the fungus produced excrescences identical with those occurring spontaneously. From the galls thus artificially produced the organism was readily re-isolated and re-inoculation tests started, which could not, however, be completed. Microscopic search failed to reveal the presence of either fungous mycelium or bacteria in the gall tissues. The chain of etiological evidence is, therefore, technically incomplete, but the author is convinced, from the results presented above, that *M. rosenwaldia* is the cause of the tumour formation.

No young trees were found affected naturally, most of those attacked being over 20 years old. In no case were galls found on wood less than 7 to 10 years old. Inoculations into young trees resulted in gumming cankers but no galls. The parasite is believed to enter the host through natural cracks in the bark which expose the deeper layers of the phloem to infection.

Satisfactory control of the disease was obtained by the excision of the galls and the application of Bordeaux paste to wounded areas.

BROOKS (F. T.) & STOREY (H. H.). **Silver-leaf disease. IV.**—*Journ. Pomol. and Hort. Science*, iii, 3, pp. 117–141, 1923.

In this paper the results of further investigations of silver leaf disease (*Stereum purpureum*) carried out since 1919 (*Journ. Agric. Science*, ix, 3, pp. 189–215, 1919) are given.

After a brief review of the distribution of the disease in different parts of the world, it is stated that a number of new host plants have been found, including roses and pears. The fungus has also been recently observed causing appreciable damage to peaches under glass, to Morello cherries, and to certain varieties of apples, e. g. Newton Wonder and Early Victoria. Severe outbreaks of silver leaf in apples and plums are now infrequent in England and can generally be traced to errors in the treatment of the trees, as for instance cutting out large numbers of branches to facilitate tractor cultivation. The susceptibility of various kinds of plum stocks has been tested by inoculation, and so far all have proved more or less susceptible.

Additional experiments have confirmed the statement previously made that *Stereum purpureum* growing saprophytically was just as capable of inducing silver leaf disease as the fungus obtained from an affected living tree.

Attention is called to the variability of the fungus. The authors consider that there is no real distinction between *Stereum purpureum* and *S. rugosiusculum* Berk. and Curt., intermediate forms being common and all being capable of causing silver leaf.

A description is given of the effect of the fungus upon invaded plum wood, including the process of gum formation. It was found that one of the chief factors in the natural recovery of silvered fruit trees is the formation, chiefly in the living cells of the invaded wood and apparently from the starch, of a gummy substance, yellow-brown in colour, insoluble in hot water, and not

stained by Delafield's haematoxylin; this gum accumulates in the periphery of the diseased wood and forms a narrow zone impermeable to the fungus.

Special attention was given to the exact means by which *Stereum purpureum* infects fruit trees in nature. It was found that any fresh exposure of living wood from one year old upwards is liable to attack, but that some types of wounds, e. g. snags and split branches, appear to be more dangerous than others; wood exposed for some time and wood already killed (e. g. by the action of other micro-organisms) is not so readily infected. Of all the protective substances tested for dressing wounds in fruit trees, the best results were obtained with gas tar, which is not injurious to the bark if carefully applied. The use of Stockholm tar for this purpose is not recommended.

Experiments were made to determine the longevity of the spores of the fungus; while at a temperature of 24° C. in a relatively dry atmosphere they completely ceased to germinate after 12 days, in a laboratory atmosphere of normal humidity and at a temperature of 15° to 20° C. some were able to germinate after 55 days although none survived 60 days; when kept part of the time in a very humid atmosphere, about 1 per cent. of the spores were still able to germinate after 60 days. Preliminary tests indicate that the optimum temperature for growth in artificial cultures is about 30° C. A table is given showing the minimum concentration of various substances found to be toxic to the fungus in culture.

Some evidence was obtained that silvered plum leaves continue to photosynthesize, but less actively than healthy ones; the translocation of carbohydrates being slowed down. Silvery leaves wilt more readily than the healthy.

The authors do not agree with the attempts that have been made to distinguish between 'true' and 'false' or non-parasitic silver leaf, since the silvering of the foliage is merely an indirect effect of attack by *S. purpureum*, and it is impossible to use the terms 'true' and 'false' in connexion with a physiological disturbance which is probably of the same nature whatever the cause.

There is, so far, no known cure for silver leaf disease, but every effort should be made, by drainage and good cultivation, manuring, &c., to facilitate the natural recovery of affected trees. Preventive measures should consist in the destruction of all dead wood within and on the confines of fruit plantations, in thinning and pruning the trees no more than is absolutely necessary, and in covering exposed tissues immediately with an antiseptic such as gas tar.

GÄUMANN (E.) **Onderzoekingen over de bloedziekte der Bananen op Celebes. II.** [Investigations on the blood disease of Bananas in Celebes. II.]—*Meded. Inst. voor Plantenziekten*, 59, 45 pp., 1 pl., 1 map, 1923. [English summary.]

Investigations in continuation of the author's earlier work on the blood disease of bananas [see this *Review*, i, p. 225] are described.

The discovery in virgin forests of wild bananas attacked by

blood disease but not by the Javanese vascular disease [see this *Review*, i, p. 223] facilitated the work of differentiation between the symptoms of the two disturbances. The general arrest of growth, which is common to plants affected by both diseases, assumes a somewhat different form in each. Whereas in the Javanese vascular disease the growth of the stem is checked but the leaves are normal until suddenly an abnormally small heart leaf is formed, in plants affected by blood disease all parts show a tendency to arrested development in the same proportion. Thus a minute stem, sometimes not exceeding 1 ft. in height, is often seen to bear a large number of small leaves, the growth of which is permanently arrested. Plants thus affected usually die in the course of a few months, while in the Javanese vascular disease externally similar symptoms may denote merely a temporary cessation of active growth. Two typical symptoms of the vascular disease, namely the diminutive size of the heart of the crown and the longitudinal splitting of the outer leaf sheaths, are absent in blood disease, though the drooping and ultimate collapse of the leaves constitute the final stage in both maladies. The yellow stripes on the leaves and the external symptoms occurring on the fruits [described in the previous paper] are peculiar to blood disease.

The internal symptoms of blood disease on the wild banana are the same as those already described for the cultivated plant. The discoloured vascular bundles occur principally in the central portion of the stem, while in the Javanese vascular disease they are found chiefly near the periphery. Characteristic of the blood disease are the large brownish-yellow spots in the tissues. The affected tissues are somewhat water soaked and emit an acid odour denoting incipient putrefaction, but this does not appear to be definitely associated with the presence of a parasite. The pulp of the fruit sometimes remains intact instead of dissolving, in which case the typical cavity with the slimy exudation at its base is replaced by a red-brown mass of dry and shrivelled tissue. This symptom occurs principally, but not exclusively, on the Pisang Radja and P. Ambon varieties.

Recent investigations have revealed the existence of two distinct types of blood disease, one acute and the other chronic. In the former case the growth of vigorous plants may be completely arrested so that death rapidly ensues, while in the latter (which generally coincides with the formation of the fruit clusters) the attack is much milder. This type commonly occurs where climatic conditions are more favourable to the growth of the plants, and is also apt to succeed severe epidemics in which the most susceptible individuals have been eradicated.

A bacterium (*Pseudomonas celebensis* n. sp. ad int.), which is regarded as the cause of the blood disease, was isolated from newly attacked fruits and grown in pure culture. The single or double rods of the organism are 0·9 to 1·4 μ in length, extremely motile, and provided with a very long polar flagellum (8 to 10 μ). Greyish-yellow colonies were formed on agar. Milk was coagulated, methylene blue (0·004 per cent.) was decoloured in 4 days, and sodium selenite (0·1 per cent.) turned brick red in 24 to 48 hours.

Some strains of the organism, which is Gram negative, formed diastase more rapidly than others. Nitrate was not reduced.

The results of inoculations with this organism [full particulars of which are given] demonstrated conclusively that it attacks primarily the vascular bundles, affecting the parenchyma only when a general weakening of the system has begun to set in and not spreading readily in a lateral direction from bundle to bundle. It was shown that, whereas inoculation of the leaf sheaths and fruits resulted only in local infection, that of the pseudostems causes a rapid spread to the rhizomes. The organism appears to secrete toxins which diffuse through agar. A quantity of the organism from culture not exceeding the size of a pin's head caused the decay, within a month, of the healthy plants into which it was inoculated. Inoculation of the soil also produced typical symptoms of the disease in the neighbouring plants. Various strains of the bacterium from different regions showed approximately the same virulence, the discrepancies being neither great nor constant enough to explain the divergence between the acute and chronic forms of the disease.

Previous observations on the dissemination of the disease were confirmed. The organism appears to retain its virulence for at least a year in the soil and for a longer period in the decaying roots. It is not yet known whether *Ps. celebensis* can attack any other plants than bananas. Infection may spread from the mother plant to the young suckers, and is also transmissible from place to place by the use of diseased seedlings. Another fruitful source of infection is the mucilage adhering to the pruning-knives, inoculation tests with which gave positive results. The recent local epidemics reported from various regions are believed to be a recrudescence of the disease due, in all probability, to unfavourable climatic conditions (especially to excessive rainfall).

The only control measures which it is possible definitely to recommend at present are the thorough cleaning out of infected plantations (which should not be replanted with bananas for at least two years) and the use of healthy stock for planting. There are some indications that the systematic use of appropriate artificial fertilizers may prove beneficial in the chronic form of blood disease, but years must necessarily elapse before the preliminary observations in this direction can be verified.

BRUNER (S. C.). **La pudrición de la corona de la Piña (Ananas sativus Schult. F.).** [Crown rot of Pineapples (*Ananas sativus* Schult. F.).]—*Rev. Agric. Com. y Trab.* [*Cuba*], v, 10–11, pp. 32–36, 5 figs., 1923. [Received 1924.]

A serious and apparently hitherto undescribed pineapple disease was observed near Havana in 1922 and found to occur only on Sugar Loaf, a variety grown for local consumption and preferred, on account of its delicate flavour, to Red Spanish, which is cultivated for export and appears to be completely immune from attack.

Infection of the parts of the plant below the crown may have progressed considerably before any external symptoms are visible, The first symptom is often the tilting of the plant to one side, but

even this is little noticeable unless the plants are well advanced in their growth. At this stage the leaves are very easily detached and show at their base a slightly darkened, water soaked area, one or more inches across, with a more or less undulating, irregular, ill-defined upper margin, while a little lower down an undefined greyish band, several millimetres broad, may be visible. In very young leaves this band is absent. The lower tender portion of the leaves rots quickly, and affected tissues are covered with a fine, white mycelium. In an advanced stage a very disagreeable, foetid odour, due to secondary bacterial invasion, is emitted, which resembles that associated with coco-nut bud rot, though not quite so strong. When the rot has gained the whole of the stem and bud, the plant gradually falls over and dries up, its colour changing to yellow.

The cause of the disease was found to be *Phytophthora terrestris* Sherbakoff, a fungus apparently well established in the Province of Havana where it is parasitic on tomatoes, citrus, and other plants. Whilst the author is aware that *P. terrestris* is regarded as synonymous with *P. parasitica* Dastur, he prefers, for the present at least, to adhere to the former name, because though morphologically the two fungi appear identical, their pathological action shows some divergence.

Inoculation experiments, which are described, gave negative results, but this may be due to a faulty technique as the mode of infection is still obscure. Further experiments are in progress.

The loss caused by this fungus in the plantation inspected by the writer amounted to 2 per cent., and at the time of the inspection the disease did not appear to be making much headway. In another case the loss was stated to be about 1 per cent.

Shady and damp localities favour the spread of the infection; hence proper draining of the soil must receive attention, and it is well not to plant susceptible varieties near or amongst shade trees, if previous infection of the soil is suspected. In Jamaica, where a similar disease appears to have been observed on the Ripley variety, Bordeaux mixture has been employed with apparent success but the author does not think that spraying is necessary in Cuba.

BERNÈS (J.). **Les parasites de l'Olivier au Congrès oléicole de Nice.** [The parasites of the Olive discussed at the Olive-growers' Congress at Nice.]—*Prog. Agric. et Vitic.*, lxxx, 47, pp. 518–524, 1923.

This is a very brief summary of the discussions which took place at the Olive-growers' Congress held at Nice in 1923, in which a short account is given of the chief fungous diseases of the tree.

Fumagine or sooty mould [*Capnodium elaeophilum*] generally follows infestation by scale insects [*Lecanium oleae*]. Preventive treatment includes, besides the destruction of the insects, better cultural methods and more frequent pruning. Several formulae for summer and winter sprays are given, and it is stated that in Spain good results have been obtained by spraying with a 3 per cent. lysol solution at the beginning of spring.

Olive knot [*Pseudomonas savastanoi*] generally follows wounds, which facilitate the entry of the bacteria. For its control better cultural methods, harvesting the fruit with care, and taking grafts or buds from healthy trees only are recommended, while the pruning tools should be disinfected after use. Affected branches should be removed and burned.

Leaf spot [*Cycloconium oleaginum*] affects not only the leaves but also the fruits. Spring and summer treatments with Bordeaux mixture (1 per cent.) are effective, but the fallen leaves should also be collected and burnt or buried.

'Brusca' [stated by Petri to be caused by *Stictis panizzei*] is characterized by reddish spots on the margins of the leaves. The disease is favoured by mist and by unhealthy conditions at the roots. Vigorous, properly manured trees are rarely attacked.

Decay of the trunk may be caused by various species of the Polyporaceae and may result in the wilting and finally in the death of the tree. Large pruning wounds are to be avoided when possible and should always be treated with tar, or with iron sulphate or copper sulphate solutions.

Root rot [*Rosellinia necatrix, Armillaria mellea*] is not frequently met with in olive plantations. The disease is difficult to check. The dead trees should be removed and the soil thoroughly disinfected before replanting, vines or other fruit trees being also subject to the disease.

FULMER (H. L.) **Insecticides and fungicides.**—*Ontario Dept. Agric. Bull.* 302 (No. 195 revised), 48 pp., 1 fig., 1 chart, 1923.

The section of the bulletin dealing with fungicides (pp. 33–48) is sub-divided into the following headings: (*a*) copper salt fungicides, comprising an account of the compositions and directions for the manufacture and application of the various types of Bordeaux mixture, copper carbonate, and copper sulphate; (*b*) fungicides containing no copper, including lime-sulphur (also discussed under insecticidal measures), formalin, corrosive sublimate, and potassium sulphide; (*c*) combination sprays and dusts; (*d*) spray calendar for fruit trees and bush fruits in Ontario; and (*e*) formulae for fungicides.

BRITTON (W. E.) & CLINTON (G. P.). **Spray calendar.**—*Connecticut Agric. Exper. Stat. Bull.* 244, pp. 183–226, 1 pl., 94 figs., 1923. [Received 1924.]

Directions are given for the preparation of the standard insecticides and fungicides, followed by a calendar for their application under Connecticut conditions. The principal fungous and insect diseases of agricultural and horticultural crops are enumerated and briefly described, appropriate treatment being indicated in each case.

ZAPPE (M. P.) & STODDARD (E. M.). **Results of dusting versus spraying in Connecticut Apple and Peach orchards in 1922.**—*Connecticut Agric. Exper. Stat. Bull.* 245, pp. 229–243, 1923. [Received 1924.]

The results of comparative experiments in the use of liquid

sprays and dusts for the control of apple scab [*Venturia inaequalis*] and other fungous diseases, including sooty blotch [*Phyllachora pomigena*], fruit speck [*Leptothyrium pomi*], bitter rot [*Glomerella cingulata*], and cedar rust [*Gymnosporangium juniperi-virginianae*], were in favour of the former method. The liquid spray consisted of 3 galls. commercial lime-sulphur, 3 lb. dry lead arsenate, $\frac{3}{4}$ pint nicotine sulphate, and 100 galls. water. The dusts used were the Sanders or copper dust (79 per cent. dehydrated lime, 13 per cent. dehydrated copper sulphate, and 8 per cent. calcium arsenate); the sulphur-nicotine-arsenate dust (superfine dusting sulphur 65 per cent., lead arsenate 10 per cent., nicotine sulphate 5 per cent., and carrier 20 per cent.); and the 90–10 sulphur arsenate dust. The apparatus used was a Niagara duster. In most cases the best results were secured by five applications on 29th April, 22nd May, 14th and 30th June, and 20th July. Sanders dust was superior to the sulphur-nicotine-arsenate in the control of scab.

Tests in the control of peach scab [*Cladosporium carpophilum*] and brown rot [*Sclerotinia cinerea*] by sulphur dust and atomic sulphur gave approximately equal results.

Womit soll man beizen? [Which are the best disinfectants?]—*Nachrichtenbl. deutsch. Pflanzenschutzdienst*, iii, 9, pp. 65–66, 1923.

The results of the 1923 experiments carried out by the Plant Protection Service at the Biological Institute, Dahlem, are briefly noted. As in former years bunt of wheat [*Tilletia tritici* and *T. levis*] was well controlled by weizenfusariol, germisan, uspulun (0·5 per cent.; the 0·25 per cent. solution recommended by the manufacturers is insufficient), formalin, and kalimat. Great care must be exercised in the application of the two last-named preparations, which are liable to injure the seed of certain varieties of wheat. Of the preparations first tested in 1923 satisfactory results were given by segetan, tillantin B (0·4 per cent.; the 0·2 per cent. solution is insufficient), and sublimoform. The sprinkling method, which is widely recommended commercially, was found to be uniformly less effectual than immersion, directions for which are given.

Stripe disease of barley [*Helminthosporium gramineum*] was satisfactorily controlled by germisan and uspulun. Roggenfusariol, germisan, and uspulun gave adequate control of the snow fungus (*Fusarium* [*nivale*]). Loose smut of oats [*Ustilago avenae*] yielded to treatment with formalin, germisan, kalimat, and sublimoform. Loose smut of wheat and barley [*U. tritici* and *U. nuda*] can be controlled only by immersion of the seed for four to six hours in water of a normal temperature (15° to 20° C.) followed by a ten minutes' dip in water heated to 50° to 52°. Rinsing in cold water or spreading out after treatment is essential. The use of copper sulphate is strongly discouraged on account of its injurious effects on germination and vigour. Formalin should only be applied shortly before sowing.

HECKE (L.). **Saatgut- und Pflanzenkrankheiten.** [Seed and plant diseases.]—*Wiener landw. Zeit.*, lxxiii, 67–68, pp. 273–274, and 69–70, pp. 281–282, 1923.

The author distinguishes between diseases carried exclusively in the seed and those which are disseminated also through the soil. To the former class belong most of the smuts, the stripe disease of barley [*Helminthosporium gramineum*], and the leaf spots of beans and peas. The snow fungus of rye [*Fusarium nivale*] is propagated chiefly on the seed, but contamination of the soil also occurs under certain conditions. On the other hand, of the three organisms responsible for root rot of sugar beet [*Phoma betae*, *Pythium de Baryanum*, and *Aphanomyces laevis*], only the first-named occurs on the seed, the others being present in the soil. Seed treatment on infested soils is therefore unlikely to give satisfactory results in the control of this disease. Scab [*Actinomyces scabies*] and powdery scab [*Spongospora subterranea*] of potatoes are also disseminated through the soil, and wart disease [*Synchytrium endobioticum*] is spread mainly in this way, though originating in infected tubers.

In regard to the common cereal smuts, the author points out that *Ustilago avenae* occupies an intermediate position between those that are only carried on the exterior of the seed and those that, like the loose smuts of wheat and barley (*U. tritici* and *U. nuda*), are strictly internal in the seed [see this *Review*, ii, p. 214].

In spite of the signal success of the recently introduced mercury seed disinfectants in many cases, a word of warning is given, in view of a number of failures for which there is no adequate explanation, regarding the need for further tests with uspulun and the like before their general adoption.

BURK (H.). **Zur Steinbrandbekämpfung des Weizens.** [Control of bunt of Wheat.]—*Zeitschr. für Pflanzenkrankh.*, xxxiii, 5–6, pp. 193–240, 1923.

After discussing at considerable length previous work in the control of bunt of wheat (*Tilletia tritici*) by seed inspection, selection and breeding, manuring, and seed disinfection, the writer describes the results of a series of disinfection experiments conducted at Giessen [Hesse-Nassau] in 1921–1922 with uspulun, tillantin B, segetan, and germisan.

Uspulun contains as effective principle 30 per cent. mercury chlorophenolate, with an admixture of alkali to secure solubility in water. No injury to germination by this preparation has been recorded; even excessive concentrations merely retard germination without inhibiting it. On seed infected with bunt spores at the rate of 0·4 gm. per 100 gm. seed, uspulun gave very good results in the control of the disease at all concentrations from 0·25 to to 1 per cent. when applied by immersing the seed in the solution for one minute to one hour, or at concentrations of 0·5, 0·75, or 1 per cent. when sprinkled. The prescribed treatment (0·25 per cent. immersion for one hour, or 0·5 per cent. sprinkling) completely prevented infection, which in the untreated controls amounted to 24·51 per cent. Immersion in the 0·25 per cent. solution for 30 minutes in cold water gave 0·06 per cent. infection;

the same strength gave complete control in water heated to 30° C. There was no infection at 0·5 per cent, when the seed was immersed for 15, 30, or 60 minutes, or at 0·75 per cent. with immersion for 5, 10, or 15 minutes. No infection occurred after immersion for 1, 2, or 10 minutes at 1 per cent., whereas after 5 minutes there was an average of 0·54 per cent. In the sprinkled plots the average infection was 0·34 per cent., sprinkling being a somewhat less reliable method than immersion.

Tillantin B [see this *Review*, ii, p. 170] contains no mercury and consists, according to the manufacturers, of a comparatively small quantity of copper in colloidal form and a slight admixture of an arsenical body. It is manufactured entirely from German raw materials, whereas the mercury used in the mercurial preparations has to be imported. Seed was disinfected with this preparation by immersion for 5 minutes to 2 hours in solutions of 0·15 to 0·5 per cent., or by sprinkling with solutions of 0·3 to 0·75 per cent. In some tests the treatment was given 8 or 14 days before sowing. The results were very satisfactory when sowing was done immediately, infection being totally inhibited by all the above concentrations except sprinkling with a 0·4 per cent. solution, which gave an average of 0·49 per cent. of bunt on three plots. The average amount of infection in the untreated control plots was 14·39 per cent. Germination, germinative energy, and vigour of the stand were all favourably affected by the treatment. There was 0·44 per cent. of infection in three plots from seed immersed in a 0·2 per cent. solution for one hour a fortnight before sowing. There was no reduction of germination or vigour, and only a very slight retardation of germination for the first five days as a result of 15 minutes' immersion in a 0·5 per cent. solution a fortnight previous to sowing.

Segetan I contains mercury cyanide and cuprammonium salts of organic and inorganic acids; in segetan II silver cyanide is substituted for mercury cyanide. The following tests were made with these preparations. (A) Seed treated with segetan I (1 to 4 per cent. immersion for 2 minutes to 1½ hours or sprinkling with 2 to 4 per cent.). (B) Segetan I (chain method, in which the quantity of disinfectant used up in the first treatment—about ¼ to ⅓—is replaced by water and half the original quantity of the preparation). (C) Segetan II (immersion for 1 minute to 1½ hours in 1 to 4 per cent. or sprinkling with 2 to 4 per cent.). (D) Comparison between segetan I and II at various concentrations, seed kept for a month before planting. The results were as follows. (A) Total freedom from infection when immersed at all concentrations tested, irrespective of the duration of immersion. The plants from seed sprinkled with a 0·2 per cent. solution showed 1·83 per cent. of bunt. In the untreated control plots there was 29·90 per cent. of infection. There was a considerable decrease in the rapidity of germination at the higher concentrations but no reduction in the germination percentage or vigour. (B) also gave completely satisfactory results. (C) gave absolute control of the disease except for a negligible incidence (0·35 and 0·13 per cent.) in the plots from seed sprinkled with the 0·2 and 0·3 per cent. solutions respectively. The untreated controls had 28·08 per cent. of infection, and those

treated in water for 1 hour 24·14 per cent. There was only a very slight retardation of germination, the ultimate condition of the stand being unimpaired. (D) Both preparations completely inhibited bunt (which occurred in the untreated controls to the extent of 18·05 per cent.) by the immersion method irrespective of concentration or duration. Sprinkling with segetan I resulted in 2·02 and 0·43 per cent. of infection at the 2 and 4 per cent. concentrations respectively, the 3 per cent. solution giving complete control. With segetan II sprinkling with the 2 or 3 per cent. solutions resulted in 0·57 and 0·6 per cent. of infection, while 4 per cent. gave absolute control. With segetan II germinative energy was somewhat reduced by the delay in sowing, except in the case of 1 hour's immersion in a 1 per cent. solution. With segetan I, however, germinative energy was higher after the delay than at immediate sowing, except in the case of 1 hour's immersion at 1 per cent. or 5 minutes at 3 per cent. Vigour was reduced by delayed sowing in both cases, except with immersion for one hour in a 1 or 2 per cent. solution.

Germisan is stated by the manufacturers to have the formula $C_6H_6ONaNHg$. In the author's tests the seed was treated by immersion in 0·25 to 1 per cent. for 1 minute to 1 hour or sprinkling with 0·25, 0·5, or 0·75 per cent. Very favourable results were obtained, except that bunt occurred to the extent of 3·02 per cent. in the plot from seed sprinkled with a 0·25 per cent. solution. The untreated plots showed 23·03 per cent. of infection. Neither germination nor ultimate vigour was impaired by any of the concentrations used, but there was a very distinct retardation of germinative energy at the higher strengths or after protracted immersion. This was particularly noticeable after 30 minutes' immersion at 0·75 per cent., when germinative energy was reduced by 93·50 per cent. and the vigour of seedlings 7 days old by 81 per cent. compared with the untreated controls. In no case, however, was any detrimental effect apparent in the final condition of the stand.

BRIGGS (F. N.). **The toxicity of copper sulfate to the spores of Tilletia tritici (Bjerk.) Winter.**—*Univ. California Publ. Agric. Sci.*, iv, 13, pp. 407–412, 1 graph, 1923.

In a culture solution consisting of a water extract of San Joaquin sandy loam soil, a 0·002 N concentration of copper sulphate was sufficient, in laboratory experiments conducted both at a controlled temperature of 58° F. and at a temperature varying between 56° to 62° to inhibit the germination of *Tilletia tritici* spores.

In concentrations of 0·0008 N and 0·001 N there was very little germination, that which did occur being distinctly abnormal in character, with short, distorted promycelia, which would probably be incapable of causing infection.

With occasional exceptions, spore germination in a 0·0006 N copper sulphate solution was abnormal. At concentrations ranging from 0·00002 N to 0·0004 N germination appeared to be normal, but spores in solutions of 0·0004 N and 0·0006 N showed a certain amount of copper injury.

DORAN (W. L.). **Toxicity studies with some copper fungicides.**—*Phytopath.*, xiii, 12, pp. 532–542, 1923.

The results of laboratory experiments carried out at the New Hampshire Agricultural Experiment Station on the toxicity of various copper fungicides on the spores of five rusts, together with *Venturia inaequalis*, *Alternaria solani*, *Rhizopus nigricans*, and *Botrytis cinerea*, showed the rusts to be on an average twice as resistant to the toxic action of copper as the other fungi, the uredospores being three times as resistant as the aecidiospores. Successful spraying with copper fungicides, with the possible exception of Johnson's mixture (copper sulphate and undecomposed ammonium carbonate in the ratio of 1 : 2), is believed to be probably impracticable against uredospore infection.

Conidia of *Venturia inaequalis* were found to be highly susceptible to all forms of copper (nine times as much so as the average of all other spores studied), equally good results being obtained with Bordeaux mixture of the 2–10–40 and 3–10–40 formulae as with 4–4–50. The addition of sugar (4 lb. in 50 galls. of 4–2–50 Bordeaux) increased the toxicity of the solution to the conidia of *V. inaequalis* four times.

Burgundy mixture was superior to Bordeaux in its action on *Alternaria solani.*

WOLLENWEBER (H. W.). **Beiträge zur Pflanzen- und Holzschutzmittelforschung. I. Vorprüfungen der Wirkung chemischer Schutzstoffe in Reisbreinährböden gegen Schadpilze.** [Contributions to the study of methods of plant and timber protection. I. Preliminary tests on the action of chemical means of protection against fungous parasites on rice mash media.]—*Angew. Bot.*, iv, 6, pp. 273–279, 1922.

After a general survey of the present status of investigations on the control of fungous parasites by chemical methods, the author describes his own laboratory experiments with *Polyporus sulphureus*, *Coniophora cerebella*, *Merulius lacrymans*, *Hypochnus* (*Rhizoctonia*) *solani*, *Verticillium albo-atrum*, and *Gibberella saubinetii.*

Rice mash media have been found to give the best results in preliminary tests of the fungicidal action of water-soluble chemical substances. Cultures of various parasitic fungi, including *Nectria*, *Fusarium*, and *Verticillium*, maintain their virulence for a long time on these media, while *Agaricus* [*Pleurotus*] *ostreatus* and *Coprinus* develop abundant fruit bodies.

The following results were obtained in the experiments, which lasted 14 to 20 days, with the above-mentioned fungi. The necessary quantity of cyanide of mercury for the complete inhibition of growth of (1) *P. sulphureus* was 1·5 gm. per litre of water used in the preparation of the medium; for (2) *C. cerebella* 1·5 gm.; for (3) *M. lacrymans* 1·6 gm.; for (4) *R. solani* 1·7 gm.; for (5) *V. albo-atrum* 1·7 gm.; and for (6) *G. saubinetii* 1·8 gm. With corrosive sublimate the corresponding figures were: (1) 1·8 gm.; (2) 2 gm.; (3) 1·8 gm.; (4) 2·7 gm.; (5) 2·5 gm.; (6) 2·7 gm. Silver nitrate: (1) 2 gm.; (2) and (3) 3 gm.; (4), (5), and (6) 4 gm. Copper sulphate: (1), (2), and (6) 5 gm.; (3) 4·3 gm.; (4) 4·7 gm. Sodium fluoride: (1) and (2) 1·2 gm.; (3) 1·3 gm.; (4) 11·0 gm.;

(5) 13·0 gm.; (6) 10·0 gm. Arsenious acid: (1) and (3) 1·0 gm.; (2) 2 gm.; (4) and (6) 21 gm.; (5) 17 gm. Dinitrophenol: (1) 0·2 gm.; (2) 0·3 gm.; (3) 0·4 gm.; (4) and (6) 8·3 gm.; (5) 8·6 gm. Dinitrophenolaniline: (1) 0·4 gm.; (2) 0·5 gm.; (3) 0·6 gm.; (4) and (5) 2·9 gm.; (6) 3·2 gm. Dinitrophenolsodium: (1) 1·2 gm.; (2) 1·1 gm.; (3) 1·4 gm.; (4) 3·2 gm.; (5) 3·1 gm.; (6) 3·0 gm.

It will be seen that the mercury compounds, copper sulphate, and silver nitrate exert a relatively uniform action on all the fungi tested. On the other hand, sodium fluoride, which exercises a strong fungicidal action on the timber destroying organisms, had to be used in large quantities to produce any effect on *R. solani*, *V. albo-atrum*, and *G. saubinetii*, which may be regarded as typical representatives of their various groups.

Sodium fluoride, especially combined with nitrated phenols, has proved very valuable as a timber preservative [see this *Review*, iii, pp. 241–3] and has the further advantage of being harmless to human beings and animals. The heavy metal salts, which are in common use at the present day as fungicides and timber preservatives, will, in the author's opinion, be abandoned as soon as equally effective non-injurious substances can be found to replace them.

Dinitrophenol and dinitrophenolaniline are by far the best timber preservatives, dinitrophenolsodium being slightly less effective. Dinitrophenolaniline is, moreover, only a degree inferior to corrosive sublimate in the control of *R. solani*, *V. albo-atrum*, and *G. saubinetii*.

GILMAN (J. C.). **Effect of hardness of water on the fungicidal value of mercuric chloride solutions.**—*Proc. Iowa Acad. Sci.*, xxix, p. 347, 1922. [Received 1924.]

A comparison of fungicidal value of mercuric chloride solutions made up in tap water with those made up in distilled water showed that the former were much less effective than the latter in destroying the sclerotia of *Rhizoctonia solani* on potato tubers. Of the 182 sclerotia treated with 1 in 1,000 corrosive sublimate in distilled water, only 6 (1·1 per cent.) gave hyphae, while in a similar test with a tap water solution 34 (7·1 per cent.) developed. In the control experiments 90 per cent. of the sclerotia developed hyphae.

MCCREA (ADELIA). **Longevity in spores of Aspergillus oryzae and Rhizopus nigricans.**—*Science*, N.S., lviii, 1508, p. 426, 1923.

In November 1919 a tube in which conidial material of *Aspergillus oryzae* had been placed 22 years previously was opened, and inoculations were made on a variety of media, one series being incubated at 37° C. and the other at laboratory temperature. In general the higher temperature was found to accelerate development.

Cultures of varying degrees of vigour were obtained, particularly luxuriant growth occurring on media with a readily available starch or sugar content of 4 per cent. or above. The morphological characters of the fungus varied with the substratum. Diastase

was vigorously produced and considerable proteolytic activity displayed. Since 1919 the strain has been successfully cultivated on Czapek's agar (Dox's modification), Sabouraud's agar (with American ingredients), and rice-flour agar.

Longevity was accidentally demonstrated, in the course of the above investigation, in *Rhizopus nigricans*, cultures of which were several times obtained from the tube.

RYTZ (W.). **Die Verbreitungsweise und das Seltenheitsproblem bei den parasitischen Pilzen, besonders bei den Uredineen.** [The method of dissemination and the problem of rarity in parasitic fungi, especially among the Uredineae.]—*Verh. Naturforsch. Gesellsch. Basel*, xxxv, 1, pp. 228–242, 1 diag., 1923. [Received 1924.]

Apart from the presence of appropriate host plants, the distribution of parasitic fungi is governed by three important factors, namely, spore dissemination, conditions of germination, and conditions of infection. While the dissemination of spores is secured, by means of wind, water, and animals, with comparative facility, the conditions for their germination are considerably more exacting. The spores of some species germinate immediately while those of others require a period of rest, and the same is true for certain categories of spores such as the short-lived basidiospores and durable teleutospores. Where the durable type of spore is not fitted for dissemination by the wind (e. g., the crust-forming teleutospores), and the spore-form that is capable of aerial transport is short-lived (e. g., the sporidia of the rusts), the continuity of the fungus can only be secured by that of the host. The absence of certain fungi from localities in which appropriate hosts are found in abundance is readily explicable by gaps in the distribution of the host and the consequent inability of the parasite to traverse the necessary distance. Thus *Puccinia oederi* on *Pedicularis oederi*, *Uromyces phacae-frigidae* on *Phaca frigida*, *U. borealis* on *Rumex arifolius*, *Puccinia pallidefaciens* on *Galium boreale*, and *P. scandica* on *Epilobium alpinum*, occur in Norway but not in the Alps.

Ecological factors must also be considered, especially in relation to the numerous cases in which the germinating spores infect the plant through young tissues, or through embryonic or short-lived organs, and need the presence of these at the moment of germination. The reaction of various fungi to a different range of phenological conditions is exemplified in the case of *Puccinia allii* and *P. porri*, the former occurring in Southern Europe and the Mediterranean area (extending to Abyssinia), and the latter in central and northern Europe.

Various examples are cited in which the presence of the host is not accompanied by that of the parasite, presumably owing to phenological limitations, and a list is given of 79 species of Uredineae, classified in groups according to their geographical distribution, which are not found in Switzerland, in spite of the abundant occurrence of their hosts in that country.

The paper concludes with a theoretical discussion on the problem of the migration of fungi from the Ice Age onwards.

(5) 13·0 gm.; (6) 10·0 gm. Arsenious acid: (1) and (3) 1·0 gm.; (2) 2 gm.; (4) and (6) 21 gm.; (5) 17 gm. Dinitrophenol: (1) 0·2 gm.; (2) 0·3 gm.; (3) 0·4 gm.; (4) and (6) 8·3 gm.; (5) 8·6 gm. Dinitrophenolaniline: (1) 0·4 gm.; (2) 0·5 gm.; (3) 0·6 gm.; (4) and (5) 2·9 gm.; (6) 3·2 gm. Dinitrophenolsodium: (1) 1·2 gm.; (2) 1·1 gm.; (3) 1·4 gm.; (4) 3·2 gm.; (5) 3·1 gm.; (6) 3·0 gm.

It will be seen that the mercury compounds, copper sulphate, and silver nitrate exert a relatively uniform action on all the fungi tested. On the other hand, sodium fluoride, which exercises a strong fungicidal action on the timber destroying organisms, had to be used in large quantities to produce any effect on *R. solani*, *V. albo-atrum*, and *G. saubinetii*, which may be regarded as typical representatives of their various groups.

Sodium fluoride, especially combined with nitrated phenols, has proved very valuable as a timber preservative [see this *Review*, iii, pp. 241–3] and has the further advantage of being harmless to human beings and animals. The heavy metal salts, which are in common use at the present day as fungicides and timber preservatives, will, in the author's opinion, be abandoned as soon as equally effective non-injurious substances can be found to replace them.

Dinitrophenol and dinitrophenolaniline are by far the best timber preservatives, dinitrophenolsodium being slightly less effective. Dinitrophenolaniline is, moreover, only a degree inferior to corrosive sublimate in the control of *R. solani*, *V. albo-atrum*, and *G. saubinetii*.

GILMAN (J. C.). **Effect of hardness of water on the fungicidal value of mercuric chloride solutions.**—*Proc. Iowa Acad. Sci.*, xxix, p. 347, 1922. [Received 1924.]

A comparison of fungicidal value of mercuric chloride solutions made up in tap water with those made up in distilled water showed that the former were much less effective than the latter in destroying the sclerotia of *Rhizoctonia solani* on potato tubers. Of the 182 sclerotia treated with 1 in 1,000 corrosive sublimate in distilled water, only 6 (1·1 per cent.) gave hyphae, while in a similar test with a tap water solution 34 (7·1 per cent.) developed. In the control experiments 90 per cent. of the sclerotia developed hyphae.

MCCREA (ADELIA). **Longevity in spores of Aspergillus oryzae and Rhizopus nigricans.**—*Science*, N.S., lviii, 1508, p. 426, 1923.

In November 1919 a tube in which conidial material of *Aspergillus oryzae* had been placed 22 years previously was opened, and inoculations were made on a variety of media, one series being incubated at 37° C. and the other at laboratory temperature. In general the higher temperature was found to accelerate development.

Cultures of varying degrees of vigour were obtained, particularly luxuriant growth occurring on media with a readily available starch or sugar content of 4 per cent. or above. The morphological characters of the fungus varied with the substratum. Diastase

was vigorously produced and considerable proteolytic activity displayed. Since 1919 the strain has been successfully cultivated on Czapek's agar (Dox's modification), Sabouraud's agar (with American ingredients), and rice-flour agar.

Longevity was accidentally demonstrated, in the course of the above investigation, in *Rhizopus nigricans*, cultures of which were several times obtained from the tube.

RYTZ (W.). **Die Verbreitungsweise und das Seltenheitsproblem bei den parasitischen Pilzen, besonders bei den Uredineen.** [The method of dissemination and the problem of rarity in parasitic fungi, especially among the Uredineae.]—*Verh. Naturforsch. Gesellsch. Basel*, xxxv, 1, pp. 228–242, 1 diag., 1923. [Received 1924.]

Apart from the presence of appropriate host plants, the distribution of parasitic fungi is governed by three important factors, namely, spore dissemination, conditions of germination, and conditions of infection. While the dissemination of spores is secured, by means of wind, water, and animals, with comparative facility, the conditions for their germination are considerably more exacting. The spores of some species germinate immediately while those of others require a period of rest, and the same is true for certain categories of spores such as the short-lived basidiospores and durable teleutospores. Where the durable type of spore is not fitted for dissemination by the wind (e. g., the crust-forming teleutospores), and the spore-form that is capable of aerial transport is short-lived (e. g., the sporidia of the rusts), the continuity of the fungus can only be secured by that of the host. The absence of certain fungi from localities in which appropriate hosts are found in abundance is readily explicable by gaps in the distribution of the host and the consequent inability of the parasite to traverse the necessary distance. Thus *Puccinia oederi* on *Pedicularis oederi*, *Uromyces phacae-frigidae* on *Phaca frigida*, *U. borealis* on *Rumex arifolius*, *Puccinia pallidefaciens* on *Galium boreale*, and *P. scandica* on *Epilobium alpinum*, occur in Norway but not in the Alps.

Ecological factors must also be considered, especially in relation to the numerous cases in which the germinating spores infect the plant through young tissues, or through embryonic or short-lived organs, and need the presence of these at the moment of germination. The reaction of various fungi to a different range of phenological conditions is exemplified in the case of *Puccinia allii* and *P. porri*, the former occurring in Southern Europe and the Mediterranean area (extending to Abyssinia), and the latter in central and northern Europe.

Various examples are cited in which the presence of the host is not accompanied by that of the parasite, presumably owing to phenological limitations, and a list is given of 79 species of Uredineae, classified in groups according to their geographical distribution, which are not found in Switzerland, in spite of the abundant occurrence of their hosts in that country.

The paper concludes with a theoretical discussion on the problem of the migration of fungi from the Ice Age onwards.

Orton (W. A.) & Godfrey (G. H.). **Dissemination of plant diseases by contaminated seed.**—*Monthly Bull. Dept. Agric. California*, xii, 6, pp. 297–299, 1923.

A considerable amount of work on seed treatment for the control of seed-borne diseases, some of the more important of which are briefly discussed, has been done for the Federal Horticultural Board in the United States during the last five years. In general the formaldehyde gas method has proved satisfactory, though various problems, which are outlined, have arisen in connexion with methods of generation, moisture and temperature relations, polymerization, and penetration. The formaldehyde is vaporized and forced into the treating chamber in the presence of steam. Condensation takes place on the surface of the seeds, forming a thin film of moisture on them in which the formaldehyde may act, and as the film evaporates the gas is freed. Lettuce and the small-seeded grasses are very susceptible to formaldehyde injury, but the great majority of seeds are not injured when the conditions are well controlled.

Promising results in the control of blackleg (*Phoma lingam*) and black rot [*Bacterium campestre*] of cabbage have been secured by the use of 1 in 1,000 corrosive sublimate, but owing to a certain reduction in germination, the method cannot yet be generally recommended. Cucumbers have been successfully treated by this means for several years for the control of angular leaf spot [*Bact. lacrymans*]. Seed-o-san, a new mercury compound, is at present being tested in connexion with onion diseases.

Seed inspection and certification may be more important than treatment in some cases. Western Washington, for instance, is still free from cabbage blackleg, and it is hoped that climatic conditions, combined with annual inspections, will keep it so. The system in force for the inspection and certification of potatoes has already contributed in a great measure to the improvement of the potato-growing industry.

Stoklasa (J.). **Die Beschädigungen der Vegetation durch Rauchgase und Fabrikexhalationen.** [The injuries to vegetation caused by smoke gases and factory exhalations.]—487 pp., 21 pl., 36 figs., Berlin and Vienna, Urban and Schwarzenberg, 1923.

This book contains a detailed discussion of the various types of injury to plants caused by the toxic gases liberated in industrial areas, and from buildings, engines, and the like.

Measures for the reduction of this nuisance are also discussed.

Allard (H. A.). **Some possible relationships of the mosaic diseases.**—*Phytopath.*, xiii, 12, pp. 555–557, 1923.

Discussing the various unsolved problems in connexion with mosaic disease, the author suggests that the virus may overwinter in infected aphids, and draws attention to the complicated cycle of development in the South African coast fever of cattle as showing the possibility that all stages of the insect vector may not be capable of transmitting infection. The possibility of the infective

virus being transmitted with fungous spores or hyphae from diseased to healthy individuals is also discussed.

DUGGAR (B. M.) & ARMSTRONG (JOANNE K.). **Indications respectin the nature of the infective particles in the mosaic disease of Tobacco.**—*Ann. Missouri Bot. Gard.*, x, 3, pp. 191–212, 1923. [Received 1924.]

The various theories advanced by different investigators to account for the mosaic disease of plants, namely, the enzyme, bacterial, the protozoan theories, are discussed and discarded as being inadequate to account for the observed facts.

A repetition of the authors' filtration work [see this *Review*, ii, p. 133] confirmed the observation that the infectious particles in tobacco mosaic approximate in size to fresh 1 per cent. haemoglobin (30 $\mu\mu$). The rapid and almost complete distribution of the disease in the tissues indicates that it is due to something which has, or is capable of assuming, a minute, attenuated form. The infective particles were found to resist partial, but not complete, dehydration by acetone and alcohol, and are thus less resistant than certain spore forms of bacteria.

The results of detailed experiments in spraying infective juice on the leaves and placing it in contact with the leaf surface for 24 hours established the fact that the viruses of tobacco and related mosaic diseases do not pass readily, if at all, through uninjured surfaces. In various types of mosaic the gametes do not seem to possess the virus; in any case the embryo arising from the fused gametes is not diseased while the seed-coats are. Possibly the reduction division is concerned in the elimination of the disease. The case of the bean is an apparent exception, though the possibility of infection after early embryonic development is not excluded.

The general trend of available evidence appears to indicate that mosaic disease is associated with a group of viruses which, apart from their abnormal activity in the cell, are completely inert. Considering all the facts, the tentative impression remains that 'the causal agency in mosaic disease may be, in any particular case, a sometime product of the host cell; not a simple product such as an enzyme, but a particle of chromatin, or of some structure with a definite heredity, a gene perhaps, that has, so to speak, revolted from the shackles of co-ordination, and being endowed with a capacity to reproduce itself, continues to produce disturbance and "stimulation" in its path, but its path is only the living cell'.

STANFORD (E. E.) & DAVY (E. D.). **Alkaloidal content of Daturas affected by mosaic injury.**—*Science*, N.S., lviii, 1509, pp. 450–451, 1923.

The results of a comparative analysis of the alkaloidal content of normal and mosaic plants of *Datura stramonium* at the Western Reserve University showed the average of the former to be lower than that of the latter (0·142 compared with 0·275 per cent. in purple-stemmed plants, and 0·072 as against 0·285 per cent. in the green-stemmed). The figures for the mosaic plants of both varieties are slightly above the official requirements (0·25 per

cent.) for stramonium as a drug. The notably low alkaloidal content of the normal leaves cannot be explained by the shaded position of the plants, since the mosaic individuals were exposed to exactly the same conditions.

MUNCIE (J. H.). **The relation of Curcurbit mosaic to wild Catnip.**—*Proc. Iowa Acad. Sci.*, xxix, p. 346, 1922. [Received 1924.]

The results of preliminary experiments showed that curcurbit mosaic could be transmitted to the catnip (*Nepeta cataria*) by the insertion of crushed mosaic leaf tissue from a gourd into the stem. Typical symptoms of the disease appeared on the tips of the catnip leaves in three weeks, and at the end of six weeks almost every leaf was affected. Mosaic of catnip has not been observed by the writer in the field, but owing to the facility of infection and chances of insect inoculation, this perennial host may be a source of early contagion to outdoor cucumbers.

BOODLE (L. A.). **The bacterial nodules of the Rubiaceae.**—*Kew Bull. Misc. Inform.*, 9, pp. 346–348, 1923.

In this note a brief summary of the literature on the leaf nodules containing bacteria found in certain Rubiaceae [see this *Review*, ii, p. 418] is given. Somewhat similar nodules are stated to have been described by Miehe in *Ardisia crispa* (Myrsinaceae).

MELIN (E.). **Experimentelle Untersuchungen über die Birken- und Espenmykorrhizen und ihre Pilzsymbionten.** [Experimental investigations on the Birch and Ash mycorrhiza and their fungous symbionts.]—*Svensk Bot. Tidskr.*, xvii, 4, pp. 479–520, 16 figs., 1923. [Received 1924.]

The results of synthetic experiments [which are described in considerable detail] showed that both *Boletus scaber* and *B. rufus* formed mycorrhiza on the birch and ash. In nature *B. scaber* occurs principally in proximity to the birch and *B. rufus* to the ash, and it is probable (though not apparent from the tests) that symbiosis is more easily effected between these respective partners. *B. edulis* did not actually produce mycorrhiza on the birch in the culture experiments, but it grew much more vigorously than when alone, even forming an incipient hyphal mantle. It is therefore concluded that, under natural conditions, it probably forms normal ectendotrophic mycorrhiza on the birch, at any rate in the absence of more powerful competitors.

Mycelium radicis sylvestris β and γ [see this *Review*, i, p. 122] isolated from the pine, also formed mycorrhiza on birch. No mycorrhiza were produced in birch or ash cultures by *B. luteus* and *B. badius*. The former, however, grew more vigorously in the company of the ash and the latter in that of the birch. *Tricholoma flavobrunnea* and *Amanita muscaria* also formed mycorrhiza on the birch. Other Hymenomycetes which grow in abundance in birch and ash woods probably act in a similar manner. It is suggested that the various types of symbiosis are influenced by such factors as chance, competition, and environmental conditions (light, humidity, hydrogen-ion concentration of the soil, and the like).

The ectendotrophic mycorrhiza produced in pure culture were exactly like those formed naturally. Two types of birch mycorrhiza were distinguished, one with clamp-connexions (*M. r. sylvestris*) and another without (*B. scaber*, *B. rufus*, *T. flavobrunnea*, and *A. muscaria*). There were no clamp-connexions on any of the synthetic ash mycorrhiza. Differences also occur in the mantles, of which the thickest (60 μ) was formed in the birch tests by *B. scaber* and *A. muscaria*, and the thinnest (25 μ) by *M. r. sylvestris* γ. It was found that *M. r. sylvestris* produced racemose mycorrhiza on the birch, whereas those it normally forms on the pine are furcate. The shape of the mycorrhiza is thus apparently determined by the higher symbiont.

The formation of pseudomycorrhiza in certain of the cultures is believed to be due in part to the insufficient virulence of the fungus in relation to a particular host, and in part to the fungus concerned being one of those which do not ordinarily take part in the formation of mycorrhiza.

The author's investigations lead him to conclude that, as in the case of conifers, the birch and ash mycorrhiza represent a mutually beneficial association. The higher partner was in no way injuriously affected by the fungus, and presumably obtains a certain amount of food by the digestion of the hyphae. In synthetic culture experiments the mycorrhizal fungi developed much more rapidly than when growing alone in pure culture.

WOLFF (J.). **Conditions favorables ou nuisibles à la germination des semences d'Orchidées et au développement des plantules.** [Conditions favourable or injurious to the germination of Orchid seeds and the development of seedlings.]—*Comptes rendus Acad. des Sciences*, clxxvii, 19, pp. 888–889, 1923.

In order to obviate the injurious effect (due to a too vigorous action of the endophyte) often arising when orchid seeds are germinated in highly concentrated media in the presence of their symbiotic fungus, the author, in conjunction with J. Potin, had recourse to the following method. The seeds were germinated, in the absence of the fungus, in Burgeff's medium in which starch had been replaced by 2·5 per cent. glucose. The seeds germinated well, though somewhat more slowly than by the usual method (from 4 to 5 weeks), and gave rise to seedlings which developed normally. Experiments made with seeds of *Cattleya* showed that seedlings raised in this way were able, when placed in contact with the fungus, successfully to resist the injurious effect of a mycelium which killed seedlings directly germinated in its presence; after 2 months the seedlings developed into vigorous, small plants, from 5 to 6 mm. high, with normal leaves and rootlets.

SCHMIDT (E. G.), PETERSON (W. H.) & FRED (E. B.). **The destruction of pentosans by molds and other microorganisms.**—*Soil Science*, xv, pp. 479–488, 1923.

Next to cellulose the pentoses are the most widely distributed constituent of plant-life, sometimes comprising 25 per cent. of the total weight of the plant.

The action of pure cultures of five species of *Aspergillus*,

Penicillium glaucum, *Cunninghamella* sp., and *Rhizopus nigricans* was tested on maize forage and rye straw. About 50 per cent. of the pentosans of the former were found to be destroyed within 100 days and about 35 per cent. of those of the latter in 300 days, *A. fumigatus* being the most active of the organisms used. The moulds did not develop on a liquid synthetic medium with wood as a source of carbon, while the addition of sucrose also failed to stimulate growth, which was evidently inhibited by some substance extracted from the wood.

When placed in soil in which a crop was grown, the pentosans of wood were rapidly destroyed (about 60 per cent. of the total content being lost in six months) by the soil organisms. A larger percentage of pentosans was destroyed than of the wood itself, showing that the former are more readily attacked than the cellulose, lignin, and other constituents of the wood.

Pentosans were found to be present as a natural cell constituent of the common fungi and are deposited in the mycelial growth to an extent of about 1 per cent. even in the absence of any pentose material in the culture medium. This mycelial pentosan complex can later serve as a source of carbohydrate for the organism. When grown on a medium containing xylose the fungi deposit more pentosans in their cells than when grown on sucrose.

FAHMY (T.). **The production by Fusarium solani of a toxic excretory substance capable of causing wilting in plants.**—*Phytopath.*, xiii, 12, pp. 543–550, 1923.

Experiments were conducted with the object of ascertaining whether *Fusarium solani* produces toxins capable of inducing wilting and whether these are enzymes. Cultures were grown on liquid media and filtered; of the resulting filtrate part was boiled to destroy enzymes and part not. Stems of broad beans inserted in tubes of the liquid were used to test wilting.

The results indicated the presence of a toxin which is not destroyed by boiling and is non-volatile. It produced a rapid wilting of the cut bean stems and increased in concentration with the age of the culture. The degree of alkalinity of the latter also increased, but not sufficiently to explain the wilt. The fungus produced ammonia and an oxalate, but not in large enough quantities to account for the toxic action of the solution.

WRIGHT (A. M.). **Moulds on frozen meats.**—*New Zealand Journ. of Sci. and Techn.*, vi, 4, pp. 208–211, 1923. [Received 1924.]

The results of investigations, begun in England in 1917 and continued in New Zealand from 1919 to 1923, on black spot of frozen mutton, are described.

The examination of specimens of meat covered with black spots revealed the growth of a mould resembling *Mucor*. All attempts at isolating the fungus in culture at a temperature of 29° to 36° C. failed, presumably because the spores had been destroyed by the low temperature in cold storage. Cultures on nutrient agar and bouillon, however, gave a Gram negative coccobacillus, which developed deep red, later dark-coloured colonies. The organism is believed to be *Bacillus prodigiosus* or *B. indicus*. Klein (*Premier*

Congrès Internat. du Froid, Pt. 2, p. 318) found, under similar conditions, a harmless aerococcus apparently symbiotic with the moulds on refrigerated meat.

Fresh investigations in New Zealand revealed the development on meat in cold storage of *Mucor mucedo*, a species of *Rhizopus*, and *Penicillium glaucum*. In only one case was *Cladosporium herbarum* [see this *Review*, iii, p. 52] definitely identified with black spot.

Black spot was found to develop when *M. mucedo* was grown on meat at temperatures ranging from $-2°$ to $-1°$C. until growth was well established, and then placed in cold storage at $-12°$ to $-15°$. Similar results were obtained with *P. glaucum*, except that the temperature of initial development was about 4° C.

All available evidence indicates that, in the stores in which mould and black spot developed on frozen meat, the temperature (which should not have exceeded $-9°$) reached at least 0°, either on several distinct occasions, or for a protracted period. Actual putrefaction was even observed in certain cases. The rise in temperature was found to be due either to defective insulation or to the admission of air while placing fresh consignments of meat in storage. Mould was found on meat stored for only one month, while other specimens maintained under strictly hygienic conditions were perfectly sound after nine years.

Attention is drawn to the development at times of feathery growths on frozen meat due to the deposit of salt crystals and organic compounds which separate from the meat juice during freezing. These have led to the rejection of meat through being mistaken for fungi.

BRANNON (J. M.). **Influence of glucose and fructose on growth of fungi.**—*Bot. Gaz.*, lxxvi, 3, pp. 257–273, 1923.

In order to test the relative effect of glucose and fructose on the development of fungi, a series of experiments, details of which are given, was carried out with *Penicillium* sp., *P. camembertii*, *Aspergillus niger*, *Fusarium* sp., and *Cylindrocladium scoparium*, all grown on Czapek's modified solution.

From the data thus obtained, as well as from a survey of the literature, it appears safe to conclude that glucose and fructose are approximately equal as tissue formers in the case of the micro-organisms investigated. Under the conditions of the author's experiments, the organisms studied utilized glucose and fructose somewhat similarly, the latter, however, appearing more favourable for *Aspergillus* and *Penicillium*.

A bibliography of 31 titles is appended.

RICHARDS (B. L.). **Further studies on the pathogenicity of Corticium vagum on the Potato as affected by soil temperature.**—*Journ. Agric. Res.*, xxiii, 9, pp. 761–770, 1 fig., 1923.

In 1918 and 1919 the author continued under natural field conditions his studies on the relationship between the pathogenicity of *Corticium vagum* on the potato and soil temperature previously conducted by him under controlled conditions in the greenhouse [see this *Review*, i, p. 261]. In soil inoculated with sclerotia the

fungus caused considerably greater damage to potato plants in 1918, when the mean daily temperature of the soil in June was 20·1° C., than in 1919 with an average daily mean of 23° for the same period. In 1918 numerous primary, secondary, and even tertiary growing tops were destroyed, in many cases entire stems being killed; and the total loss in yield was 50 per cent. as compared with a total loss of 15·4 per cent. in 1919. In the latter year the organism caused a greater destruction of the growing points and a more severe type of cortical injury to the early potato plants sown on 26th April and 7th May, than on the later plantings of 17th and 30th May, a sudden rise in the soil temperature having occurred in time to allow the later crops to start their growth in a very warm soil. In the earlier crops, secondary primordia from shoots severely injured in the cold soil later grew uninjured through warm soil. While the fungus, as was shown by the previous studies, may produce lesions on the underground parts of the potato over a relatively wide range of soil temperature, the general indications are that variations in the mean soil temperature of two or three degrees above or below 21° C., during the first few weeks after sowing, may determine the damage to the crop in any one season.

Paginas del Agricultor: La verruga negra (Black wart) de la papa. [Section for the grower: Black wart disease of Potatoes.]—*Rev. de Agric. Com. y Trab.* [*Cuba*], vi, 10–11, pp. 4–5, 1923.

Black wart disease of the potato (*Chrysophlyctis* [*Synchytrium*] *endobioticum*) has so far not been recorded in Cuba, where, however, the following potato parasites, amongst others, have already been introduced with seed tubers: *Actinomyces scabies*, *Phytophthora infestans*, *Macrosporium solani*, *Fusarium* sp., and *Bacillus phytophthorus* [*B. atrosepticus*]. In order to put growers on their guard against wart disease, an account of it by S. C. Bruner, head of the Department of Phytopathology and Economic Entomology at the Cuban Agricultural Station, is quoted.

At the present moment the varieties chiefly cultivated in the island are Early Rose and Bliss Triumph, of which the former is very susceptible to the disease and the latter partly so; hence the introduction of this disease would be a calamity, which the government is urged to guard against by legislation directed chiefly against European imports, as no American potatoes are admitted.

Waksman (S. A.) & Starkey (R. L.). **Partial sterilization of soil, microbiological activities and soil fertility. II.**—*Soil Science*, xvi, 4, pp. 247–267, 16 graphs, 1923.

In continuation of the experiments described in their first paper [see this *Review*, iii, p. 175] the authors prepared a soil in which the activities of the soil micro-organisms, as tested by counts, nitrate content, and CO_2 production, were approximately constant during successive periods of time; in other words, in which a uniform balance of microbiological activities had become established.

With this soil, tests were made of the influence of various treat-

ments on the number and activities of bacteria, actinomycetes, fungi, and protozoa already present in it. Treatment with 0·5 per cent. calcium oxide caused a decrease in the numbers of bacteria and fungi until carbonation took place, when there was a rapid rise. Reasons are given against attributing this effect to the destruction of protozoa by the treatment. Calcium carbonate (1 per cent.) caused no very decided change. Air-drying followed by moistening had a strong stimulating effect on the numbers of bacteria and fungi, but the effect was transitory; protozoa were not destroyed. Heating the soil to 65° C. for an hour caused a decrease, followed by an increase, in the numbers of bacteria and fungi. The protozoa disappeared for about 28 days, after which they became very numerous. The fungi continued to increase slowly even after 80 days, while the bacteria diminished again. The increase of the fungi is considered to be more closely correlated with change in the bacterial numbers and nitrate content of the soil than with the presence of protozoa.

Treatment with toluene resulted in an increased rate of CO_2 production, followed by rapid decrease; this was accompanied by a decided increase in bacterial numbers, which remained at a high level for a long time, and even after 130 days the numbers were still almost twice as high as in the untreated soil. The fungi were practically destroyed as a result of the treatment, and only began to increase slowly; the most noticeable survivors were *Zygorhynchus*, *Penicillium*, *Cunninghamella*, and *Cephalosporium*. The protozoa disappeared for 28 days. Nitrates were greatly diminished and only began to increase after a long period.

Carbon bisulphide (1 per cent.) produced phenomena very similar to those following toluene treatment, soil-heating, air-drying, and CaO treatment. The rapid rise, after a considerable period, in the numbers of fungi coincided almost exactly with a precipitous drop of bacterial numbers.

The addition of 0·2 per cent. of ground dry lucerne meal produced changes in the microbiological activities very similar to those caused by partial soil sterilization.

The addition of 500 mg. of sulphur to 1 kg. of soil caused a slight decrease in bacterial numbers, a slight rise in the number of fungi, and a small increase in the CO_2 producing capacity of the soil. The increase in soil acidity made the soil a poorer medium for the growth of bacteria and a better one for the growth of fungi.

Sherwin (M. E.). **Soil treatments to overcome the injurious effects of toxic materials in eastern North Carolina swamp land.**—*Journ. Elisha Mitchell Sci. Soc.*, xxxix, 1–2, pp. 43–48, 1923.

The soil of the area under discussion is deep peat, 90 per cent. organic, loose and open on the surface but passing at a depth of 6 to 8 inches to an impermeable, light brown material. The lime requirement has been estimated at slightly over 1 ton $CaCO_3$ per acre inch, and the P_H values have been determined as 3·5 to 5.

Spots designated as 'poor' appear sporadically in the crops without any obvious physical differences in the soil. The nodal tissues of maize growing in the whole affected area are more or less

discoloured, and particularly so in the 'poor' spots. This phenomenon has been ascribed by Hoffer (in correspondence) to iron accumulations [see also this *Review*, iii, pp. 32, 33].

Experiments consisting of 13 cultural treatments have been carried on for a year. Ridging the land so as to allow a maximum of field drying resulted in an increase in the maize crop of 20 to 100 (average 45) per cent. over flat cultivation. The average increase of yield from the various cultural treatments ranged from 1 per cent. (1 to 4 tons limestone per acre) to 60 per cent. (nitrate of soda with kainit and limestone). The application of acid phosphate (320 lb. per acre) resulted in a loss of 20 per cent., which was reduced to 6 per cent. when limestone was added, and 1 to 4 per cent. with nitrate of soda. Nitrate of soda alone (160 lb. per acre) gave remarkably beneficial results (40 per cent. increase) but was incapable of entirely overcoming the markedly depressing effects of acid phosphate. Kainit, however, counteracted the adverse influence of acid phosphate in every combination.

Hoffer's investigation of the maize plants grown in the treated area showed that the increase of yield was roughly proportionate to the depression of iron accumulation, and he assumes that the toxic material present in the soil is soluble iron.

Presumably the stimulatory action of kainit on the crop is due to the effect of its potash on the entrance of iron into the plant. Potash appears to enable the plant to withstand otherwise toxic amounts of iron compounds, while the chlorine of kainit assists the passage of potash into the plant. The sodium of kainit furnishes a base to combine with the nitrates produced by nitrification, the resulting compound being stimulating as well as non-toxic. The combination of sodium with nitric acid reduces the amount of ferric nitrate which may be formed.

Nitrate of soda assists the entrance of potash into the plant, supplies a beneficial nitrate, and depresses nitrification.

Acid phosphate retards the entrance of potash into the plant, thereby facilitating the accumulation of toxic iron.

Lime at the rate of 20·3 tons per acre has given better results than when used in greater or less quantities. This appears to be due to the synergistic action of calcium on potash, a smaller amount being probably insufficient and a larger one stimulating nitrification. No direct relation is apparent between the effect of lime and the lime requirement of the soil as determined by the Veitch method.

The effect of lime on the ridged land was not significant, probably because the aeration in these parts of the field was sufficient to prevent the retention of soluble iron.

DASTUR (J. F.). **The Mosaic disease of Sugarcane in India.**—*Agric. Journ. India*, xviii, 5, pp. 505–509, 1 pl., 1923.

A small outbreak of mosaic of sugar-cane occurred at Pusa in 1921, this being the only case so far recorded of the presence of the disease in India. The varieties attacked were D 99 (which had been first obtained from America and of which a few setts were under experiment) and Sathi 131 (a cane originally received in 1912 from a factory at Sathi in Bihar), about an acre of which was growing

on the Pusa Farm. Both varieties were found unsatisfactory for local cultivation, no doubt partly on account of their diseased condition. The whole of the infected crop of Sathi 131 was uprooted and burnt and its cultivation has been discontinued.

It is impossible to determine whether the disease was first brought in on the original imported setts of D 99, on those of Sathi 131, or on both, but the important point is that the disease has been present on these varieties at Pusa certainly for one year and possibly for as many as eleven years. A careful search showed, however, that the other varieties grown for years side by side with D 99 and Sathi 131 have so far remained free from the disease. No carriers of mosaic could be found among the insects that occur generally on the sugar-cane at Pusa. Juice of D 99 was proved capable of infecting Sathi 131, which in turn was shown to be able to attack the Hemja variety but not Saretha.

BRUNER (S. C.). **La enfermedad del mosaico de la Caña de Azucar.** [Mosaic disease of Sugar-cane.]—*Est. Exper. Agron. Santiago de les Vegas Circ.* 60, 16 pp., 4 pl. (1 col.), 1 map, 1923. [Received 1924.]

Mosaic disease of sugar-cane, first recognized in Cuba in 1915, has since been making rapid strides, and most of the important cane-growing centres show an increasing percentage of infection. The losses are estimated at from 20 to 40 per cent. (according to whether plant or ratoon cane is grown), or more under adverse climatic conditions.

The present circular gives an account of the history, distribution, cause, symptoms, and mode of propagation of the disease, together with a section devoted to a discussion of the best methods of control. The cane variety chiefly grown in Cuba is Cristalina, which is fairly resistant. The formation of lesions (sometimes called cankers) on the internodes, in the shape of irregular, longitudinal stripes, which is sometimes a secondary symptom of mosaic, rarely occurs on Cristalina, nor is the shortening of the internodes, stated to be often associated with the disease, a constant feature in this variety. The tender leaves of the bud show the first symptoms, and in the more resistant varieties this is the only reliable means of identifying the disease. Its spread is brought about solely by aphids, of which the most important is *Aphis maidis*. This insect attacks sugar-cane only when its usual, and greatly preferred, hosts, maize, sorghum, and certain other grasses, have withered. Hence it is dangerous to grow these plants in the vicinity of sugar-cane plantations.

As no curative methods are known, special attention must be paid to preventive measures. Only healthy seed pieces should be planted. Experience has shown that even the planting of a fraction of 1 per cent. of affected setts is followed by the infection of 50 to 75 per cent. of the stools within a year. Legislation passed in 1919 prohibits the export of seed pieces from infected areas. Immune or resistant varieties should be grown. Completely immune are the 'Japanese' canes Uba (or Kavangire), Cayana 10, and Zwinga, which are all referred to a distinct species, *Saccharum sinense* Roxb. The first-named is stated to be the best, and its

yield is not very inferior to that of the Crystalina. On the other hand, it is not suitable for low-lying, humid, and very fertile soils, where it does not ripen well. It is now grown experimentally in some parts of Cuba. The varieties reputed to be tolerant of mosaic viz., Java 36 (G.Z. 36 P.O.J.), Java 234, D.-1135, and Badila (or New Guinea 15) have not as yet been tested in Cuba. In partially infected plantations an effort should be made to eradicate the disease by roguing. This can only promise success in plantations where there is less than 15 per cent. mosaic, though in plant cane this operation can safely be carried out with about 30 per cent. infection. Diseased plants must be rooted up, and may safely be left in the furrows to dry. The roguing must be repeated every 8 to 10 days until the disease has been stamped out. The cost in an important Cuban plantation, where this method has been tried, worked out at an average of \$23·59 per caballeria [\$0·71 per acre], which is not considered excessive.

Sugar and mosaic disease of Canes, &c., &c.—*Journ. Jamaica Agric. Soc.*, xxvii, 8, pp. 864–869, 1923.

At a meeting of the Imperial Association at Kingston, Jamaica, Mr. Hansford, the Government Microbiologist, read a paper of which the following is a summary.

Mosaic disease has spread to a considerable extent in Westmoreland, less so in Vere, and in Trelawny it has been almost completely eradicated from some estates, while on others a campaign against it is in progress.

Cane fields may be infected in one of two ways. In the so-called primary infection the planting of diseased tops is responsible for 90 to 100 per cent. of mosaic in the young crop. The shoots arising from ratoon roots also show a high percentage of disease.

In the case of secondary infection healthy shoots become infected after showing above the ground. All the leaves and joints formed after the infection of the growing point show the disease, and the 'eyes' will give only mosaic plants.

The evidence that mosaic disease is aerially transmitted is rapidly accumulating, and seems convincing. Many workers in different parts of the world have tried interplanting rows of diseased canes with healthy tops, the latter in many cases contracting the infection after three to six weeks. Infection has been found to vary in extent and intensity at different times, suggesting a correlation between some external factor and the incidence of mosaic. No such connexion, however, has been definitely proved, and the results of observations on these lines in Jamaica are very conflicting.

Owing to the transmission of the disease from maize to sugarcane by *Aphis adusta* [*A. maidis*] [see this *Review*, ii, p. 381], the planting of the former on and near sugar estates will shortly be prohibited.

Under Jamaica conditions the loss of tonnage due to mosaic disease is estimated to vary from 15 to 45 per cent. On some estates a good tonnage is raised in spite of mosaic, but the effect of the disease is cumulative in the ratoon crops, the second ratoons being hardly worth harvesting. The corresponding reduction in the yield of juice ranges from 1 to 12 per cent. The White Trans-

parent and Ribbon canes are resistant to mosaic and the Uba immune.

The measures suitable for the control of the disease may be divided into two classes :—(1) those to be adopted where there is less than ten per cent. of infection ; and (2) those applicable where the percentage is high. In the former case systematic roguing, from the time the plants are 6 to 12 in. high, will completely eliminate the disease. After the canes are three months old, it is sufficient to remove the infected portions, leaving the rest of the plant intact in order to maintain the regularity of the stand.

In the case of severe infection it is necessary to eliminate the entire crop and replant the field with healthy tops. The land should be left bare for a month or two and cultivated with the plough or fork to eradicate all remains of the previous crop which may be capable of infecting the new canes. On large estates where this method is impracticable the cultivation of the immune Uba variety should be undertaken. At the same time a nursery of healthy estate canes should be prepared, these being used later to replace the Uba, if desired. During the second and third years the process should be repeated, until finally a continuous, wide belt of Uba cane acts as a barrier between the new planting of clean estate cane and the old diseased ratoons.

FAWCETT (G. L.). **La transmisión del mosaico de la Caña.** [The transmission of Sugar-cane mosaic.]—*Rev. Indust. y Agric. de Tucuman*, xiii, 7–8, pp. 129–131, 1923.

The discovery in the Argentine of *Aphis maidis*, which is regarded as the most important transmitter of sugar-cane mosaic, led the author to carry out experiments with a view to checking the results obtained by other workers. In the first test healthy and diseased canes were caged, and on the terminal leaves of both healthy and diseased plants diseased cane leaves bearing the aphids were laid. The result was negative, except in the case of one plant which, after 6 weeks, showed the symptoms of mosaic. In another experiment the diseased leaves, bearing aphids, were placed on healthy canes, which were isolated in cages. No mosaic developed on any of the plants. The author thinks that these negative results may possibly be due to the absence of some condition necessary for the migration of the insects from one plant to another. Another explanation is that the disease may actually have been communicated, but the appearance of symptoms was delayed.

It is clear, however, that the presence on healthy canes of a considerable number of aphids from diseased canes does not necessarily bring about rapid infection.

It is difficult to believe that *A. maidis*, which is so extremely rare an insect on sugar-cane (the specimens used in the experiments were found only after a long search on some delicate varieties of cane), can be of great importance in the carrying of mosaic, and one is forced to look for other transmitting insects. The author's tests with a yellow aphid—still undetermined but resembling the Javanese *A. sacchari* Zehnt—were again negative [see this *Review*, ii, p. 339]. It is thought that insects which feed only on mature

leaves cannot be important transmitters, as inoculations of these leaves have never been successful. The inoculation of growing points, however, has always given positive results, and the fact that *A. maidis* has its habitat in this portion of the plant is no doubt the cause of its transmitting powers.

Importation of Potatoes.—*Journ. Dept. Agric. S. Africa*, vii, 3, pp. 265–267, 1923.

The measures applied by the Department of Agriculture of South Africa for preventing the introduction of black scab or wart disease (*Synchytrium endobioticum*) and bacterial plant diseases along with the importation of potatoes are described.

Consignments from oversea are admitted only through certain ports. If, on inspection, any package contains tubers attacked by a pathogenic bacterial disease, e. g., *Bacillus solanacearum* or *B. solanisaprus* [*B. atrosepticus*], that package and also all packages bearing the same marks in which 15 per cent. or more of the tubers are decayed, will be excluded from entry, while packages containing less than 15 per cent. will be passed, provided no trace of the above-mentioned bacterial diseases is found in them. Consignments will be refused permission to enter if they contain tubers with wart disease, but they will not be excluded on account of insect injuries, uninfectious scabs, *Oospora* scab, *Rhizoctonia*, *Phytophthora* blight, *Fusarium* decay, or non-pathogenic bacterial rots. The Government, however, reserves its right to reject any suspected packages.

The documentary requirements, which are recapitulated, remain practically as before. Examples of the consignor's declaration form and of the official certificate *re* wart disease are given. It is stated that no '*Phylloxera*' declaration is required in connexion with potatoes or other produce introduced into S. Africa.

HENNING (E.). **Berberislagen och Berberisutrotningen.** [The Barberry Act and Barberry eradication.]—Reprinted from *Kungl. Lantbruksakad. Handl. och Tidskr.*, 15 pp., 1 fig., 1923.

An account is given of the Swedish Barberry Act which came into force on 1st August 1918, and of the discussions which preceded and followed it, while the excellent results in the control of black stem rust of wheat [*Puccinia graminis*] secured by legislation in other countries are briefly outlined. Referring to the difficulties of mechanical eradication of the barberry shrub, the author describes a method for its destruction by means of salt [see this *Review*, ii, p. 399], which can be obtained from smoked herring factories at the cost of kr. 2 [about 2*s.* 6*d.*] per barrel (120 litres). This quantity suffices for the treatment of at least 50 medium-sized bushes.

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Liro (J. I.). **Die Ustilagineen Finnlands. I.** [The Ustilaginaceae of Finland. I.]—*Ann. Acad. Scient. Fennicae*, Ser. A, xvii, 1, xviii + 636 pp., Helsingfors, 1924.

This important work comprises the first part of the author's researches on the smuts of Finland. The genera *Sphacelotheca* and *Ustilago* are completed, and the species described include not only those occurring in the country but also all whose hosts occur in Finland. The first part (of 116 pages) is devoted to systematics, and the recorded species are listed with full citations of literature and exsiccata, notes on localities, collectors, dates, &c. In the second part the author discusses the relevant literature under each species and records the results of his own germination and infection experiments, as a result of which he has erected a number of new species, namely, three of *Sphacelotheca* and seven of *Ustilago*. The work closes with a bibliography of 76 pages and a combined fungus and host index.

Cunningham (G. H.). **The Uredinales or rust fungi of New Zealand: Part I. Pucciniaceae, tribe Puccineae (containing descriptions and illustrations of seventy-five species).**—*Trans. & Proc. New Zealand Inst.*, liv, pp. 619–704, 1 pl., 76 text figs., 1924.

This important monograph deals with four genera: *Uromyces* (13 spp.), *Uromycladium* (4 spp.), *Puccinia* (57 spp.), and *Gymnoconia* (1 sp.). Of the 75 species discussed, 46 are indigenous and 23 of these are endemic. The species of each genus are arranged according to the natural order of the host plant. There is a full description in English of each species, with collectors' names, localities, and dates. Information of general interest follows. Latin diagnoses of the 23 new species are given at the end of the paper. There is a bibliography of 45 titles and a combined host and fungus index.

Brooks (R. St. J.) & Rhodes (Mabel). **A list of fungi, &c., maintained in the National Collection of Type Cultures.**—*Trans. Brit. Mycol. Soc.*, ix, 1–2, pp. 95–99, 1923.

In the present paper is given a list of fungi and bacteria of economic interest at present maintained in the National Collection of Type Cultures, Lister Institute, Chelsea Gardens, London. In all applications for cultures the reference numbers given should be quoted. A small charge is made in most cases, to cover packing and postage expenses.

Schellenberg (H. C.). **Infektionsversuche mit Vertretern der Gattung Sclerotinia.** [Inoculation experiments with representatives of the genus *Sclerotinia*.]—*Actes Soc. Helvetique Sci. Nat.*, civ, pp. 161–162, 1923. [Received 1924.]

The species of *Sclerotinia* occurring in a parasitic form on Prunoideae and Pomaceae may be divided into the following three groups.

Non-specialized forms, including *S. fructigena*, *S. cinerea*, and *S. laxa*, occurring on all Prunoideae, Pomaceae, and the fruits of *Vitis vinifera*, *Fragaria*, and *Vaccinium*.

Specialized forms on Prunoideae, including *S. cerasi* on *Prunus cerasus*, *S. linhartiana* on *P. padus*, *S. pruni-spinosae* on *P. spinosa* (these three species have not yet been observed in Switzerland).

Specialized forms on Pomaceae, including *S. aucupariae* on *Sorbus* [*Pyrus*] *aucuparia*, *S. ariae* on *S.* [*P.*] *aria*, *S. mespili* on *Mespilus germanica*, *S. crataegi* on *Crataegus oxyacantha* and *C. monogyna*, and *S. cydoniae* on *Cydonia vulgaris*.

All these forms are provided with two means of causing infection. Both ascospores and conidia can infect the leaves, while the conidia are also able to produce infection of the embryo through the stigma and thus to form sclerotia. These stigma inoculations with conidia are easily carried out. The non-specialized forms germinate readily on the stigmata of both Prunoideae and Pomaceae and destroy the embryo. In the specialized forms germination of the conidia occurs both on the stigmata of the host and on those of other related plants. The development of the sclerotium, however, takes place only in the true host, hyphal growth ceasing at a given point in all other plants.

Inoculation tests with ascospores and conidia showed that only young, growing leaves and shoots were susceptible to infection. Thebuds were found to become infected as soon as the bud leaves expand, especially with *S. cydoniae*. The germ-tubes of the ascospores penetrate through the young epidermis; the conidia, besides this form of infection, also enter through wounds and stomata. Infection of the leaves is always accompanied by the production of conidial masses, which are the only reliable indication of successful inoculation.

S. cydoniae was found to be readily infectious to quince, but not to *Mespilus*, *Crataegus*, *Prunus cerasus*, *P. padus*, or *P. avium*, and is therefore distinct from *S. crataegi*, with which it has been confused. *S. crataegi* is not transmissible to quince, *Mespilus*, or *P. padus*, while it readily infects *Crataegus oxyacantha* and *C.*

monogyna. *S. ariae* is not transmissible to *Sorbus* [*Pyrus*] *aucuparia*, nor *S. mespili* to *Crataegus* and *Cydonia*.

A *Sclerotinia* is frequently observed on the hybrid *Mespilus germanica* × *Crataegus monogyna*. The results of cross-inoculation experiments indicate that this is identical with *S. crataegi*, since the conidia infected *Crataegus* leaves and flowers and not those of *M. germanica*.

HOGGAN (Miss T. A.). **On Dematium pullulans de Bary.**—*Trans. Brit. Mycol. Soc.*, ix, 1–2, pp. 100-107, 1923.

The author briefly describes an investigation of the relations of *Dematium pullulans* to *Cladosporium herbarum* and *Plowrightia ribesia*. In regard to the former no evidence has been obtained during the work at Cambridge on black spot of frozen meat [see this *Review*, iii, p. 52] or the author's studies of *Dematium* that there is any genetic relationship between the two fungi, and an examination of the literature has not revealed satisfactory evidence of such a relationship. Strains of *Dematium* obtained from various sources and grown on different media side by side with strains of *Plowrightia ribesia* isolated from red and black currant bushes, agreed closely in behaviour and in morphological characters amongst themselves but showed macroscopic and microscopic differences from the cultures of *Plowrightia* sufficiently striking to leave no doubt that they were distinct entities. The budding form of mycelium observed in *Plowrightia* is, on many media, widely different from that of *Dematium*.

TUNSTALL (A. C.). **Some observations on stem and root diseases.** —*Quart. Journ. Indian Tea Assoc., 1923*, 3, pp. 86–91, 1923.

The following root and stem diseases of tea are briefly described with general directions for their control.

Corticium spp. causing elongated cankers on the stems and forming fine threads, distinct from those of the commoner thread blights, on the surface of the bark. More than one species is concerned, some spreading to the leaves while others are confined to the stem. Subsequent infection by *Botryodiplodia theobromae* and *Auricularia auricula-judae* frequently kills the branches and may extend to the roots.

Pestalozzia sp., similar to, if not identical with, *P. theae*, causing curious irregular swellings on the stems, often marked in the early stages by small cracks through the old bark. Inoculations from pure cultures showed the fungus to be a wound parasite and the cause of the swellings. The disease followed severe attacks of mosquito blight.

Nectria cinnabarina is stated to cause considerable damage by killing back the stems.

Blue and brown velvet blights (*Septobasidium* spp.) apparently cause no injury, though they look alarming.

Root diseases caused by a species of *Diplodia* (differing in some respects from the common *Botryodiplodia theobromae*), at least two species of *Poria* (one with a white or cream-coloured mycelium and the other pinkish), a *Polyporus* with white fructifications in clusters

just above the collar and a white mycelium, and *Fomes lucidus* are briefly described.

Special emphasis is laid on the importance of proper aeration and cultivation of the soil in all cases of root disease. For the control of stem diseases, in addition to the ordinary cultural measures, it is recommended to spray with a stock solution of lime-sulphur diluted five times and to paint pruning cuts with a paste consisting of 4 lb. copper sulphate to 1 gall. hot rice water, with sufficient slaked lime to form a paste.

DICKSON (B. T.). **A study in disease susceptibility.**—*Scient. Agric.*, iii, 9, p. 307, 1 fig., 1923.

Tobacco plants at Macdonald College, Quebec, were inoculated in October 1922 with mosaic and developed the usual symptoms. On the 27th November numerous minute spots were observed on several of the lower leaves of the diseased plants. The spots, which at first were water soaked and about the size of a pin's head, turned dark brown and finally almost white. Zonation was frequent, and on some leaves coalescence of the lesions also occurred. Infection spread slowly, as a result of the splashing of water, from one leaf to another. Adjoining plants not suffering from mosaic remained quite free from the disease in spite of repeated attempts to infect them. Cultures from infected material have so far yielded only a micrococcus, but further studies are in progress on the etiology of the disease.

VALLEAU (W. D.). **The control of angular leaf-spot and wildfire of Tobacco.**—*Kentucky Agric. Coll. Circ.* 162, 4 pp., 1923. [Received 1924.]

Angular leaf spot of tobacco [*Bacterium angulatum*: see this *Review*, ii, p. 476] is stated to be very widespread in Kentucky, where it was found in over 90 per cent. of the seed-beds and fields during 1923. Wildfire [*Bact. tabacum*: see this *Review*, iii, p. 105] was observed on only 5 per cent. of the area inspected, but is liable to assume an epidemic character at any time, and should be rigorously suppressed. The principal sources of infection and measures for the control of both diseases [fully discussed in previous abstracts] are briefly indicated.

SHERWOOD (E. C.). **Hydrogen-ion concentration as related to the Fusarium wilt of Tomato seedlings.**—*Amer. Journ. of Botany*, x, 10, pp. 537–552, 1 pl., 1923.

Investigations were carried on at the Wisconsin Department of Plant Pathology with a view to supplementing those of Clayton on the influence of temperature and moisture [see this *Review*, ii, pp. 428, 477] upon the development of tomato wilt (*Fusarium lycopersici*). Edgerton (*Phytopath.*, viii, p. 5, 1918), in his work on the correlation between soil reaction and the development of wilt, has demonstrated the importance of liming in the reduction of the disease. Both these investigators and the author found that, within reasonable limits, the age of the culture does not appreciably affect the virulence of the organism.

The experiments described in the present paper were conducted

on acid sandy and silt loam soils, adjusted to different degrees of acidity and alkalinity and inoculated with *F. lycopersici*, in a greenhouse where the temperature was maintained at or near 28° C., the optimum for the development of the disease.

It was found that the highest percentage of wilt uniformly occurred in the most acid soils of the series, decreasing, in almost every case, with a reduction in the hydrogen-ion concentration until approximately P_H 7·4 was reached: no limiting degree of acidity or alkalinity was found at which the disease would not develop. The amount of infection, however, showed considerable variation under the conditions of the several experiments. It is evident, therefore, that other influential factors, such as nutrition, aeration, and organic matter content, play an important part in the development of the disease. Considerable differences were also observed in the incidence of disease in the two types of soil at the same hydrogen-ion concentration.

The critical period of infection in the seedlings appears to occur within the first few days after germination. The primary xylem was always found to be affected.

Cultural experiments were carried out with *F. lycopersici* in nutrient solutions adjusted to hydrogen-ion concentrations ranging from P_H 1·8 to 8·4. Spores of the organism exposed to the same temperatures as the growing tomato seedlings germinated in the solutions varying between P_H 2·2 to 8·4. No germination occurred at P_H 1·8, and the growth of the fungus at P_H 2·2 was so slight as to cause no change in the reaction of the medium. Growth was good at all concentrations from P_H 2·8 to 8·4; in one case there was a slight change at the former concentration in the reaction of medium towards greater alkalinity. At all hydrogen-ion concentrations from P_H 3·6 to 8·4, the growth of the organism was accompanied by changes towards greater acidity.

HOTSON (J. W.) & HARTGE (LENA). **A disease of Tomato caused by Phytophthora mexicana sp. nov.**—*Phytopath.*, xiii, 12, pp. 520–530, 2 pl., 1 fig., 1923.

Cultural studies [particulars of which are given] resulted in the determination of a fungus isolated from Mexican tomatoes shipped to Washington as *Phytophthora mexicana* n. sp., English and Latin diagnoses of which are given. The average diameter of the mycelium is 7·7 μ, the conidia measure 16 to 33 by 16 to 77 μ, and most of the oospores 37 μ. The conidiophores arise as simple, stout branches, at the apex of which a conidium develops. Further conidia are formed as a result of renewed growth of the conidiophore below the tip, the stalks of the first-formed ones becoming elongated meanwhile. The ultimate result is often a cymose head of conidia. Chlamydospores were occasionally produced. Both sexual and asexual spores were formed on all the media used.

Some doubt exists as to the relation between the antheridium and oogonium. In many cases the antheridium appeared to be pierced by the oogonial stalk, while in others there were indications of growth of the oogonial incept up along the outside of the antheridial wall.

Artificial inoculations on old and young tomato plants resulted

in a black wilt, while inoculation of the fruit caused a destructive decay in a week. The hyphae were mostly intercellular but were sometimes found within the cells of the stem tissues.

The other species of *Phytophthora* known to attack tomatoes are stated to be *P. infestans*, causing blight; *P. terrestris*, causing buckeye rot; *P. cryptogea*, the agent of collar rot; an undescribed and unnamed *Phytophthora* causing damping-off and stem girdling (*Phytopath.*, x, p. 528, 1920); [and *P. nicotianae*: see this *Review*, iii, p. 107].

Lo Priore (G.). **The 'ink' disease of the Chestnut.**—*Intern. Rev. of the Sci. and Pract. of Agric.*, N.S., i, 3, pp. 600–607, 1923.

In this paper the author gives an account of the present state of knowledge regarding the ink disease of the chestnut [see this *Review*, iii, p. 245], and the work of Briosi, Farneti, Petri, Mangin, Dufrénoy, and Blin in this field is reviewed. The author inclines to Petri's opinion that the disease is primarily due to the attack of *Blepharospora cambivora* and that *Coryneum perniciosum* causes a secondary infection of trees already suffering from ink disease.

South (F. W.). **The treatment of a root disease of Borneo Camphor.**—*Malayan Agric. Journ.*, x, 7–9, pp. 217–218, 1923.

In this brief note the statement is made that the outbreak of *Rosellinia bunodes* on Borneo camphor (*Dryobalanops aromatica*) recorded by the author in 1921 in the Kanching Forest Reserve, Selangor [see this *Review*, i, p. 95], has been successfully checked as a result of four months' treatment in that year on the lines described by him in his previous article. In practice it was found, however, that a much smaller area needed to be trenched than was expected, a radius of 3 feet from the tree attacked being sufficient. It was also found that the virulence of the fungus had perhaps been over-rated, or the efficiency of lime under-estimated, as in many cases the seedlings grown in the entrenched area did not contract the disease. No further attacks have been reported to the Agricultural Department since the treatment was completed.

Departmental Activities: Botany.—*Journ. Dept. of Agric. S. Africa*, vii, 5, p. 392, 1923.

Fructifications of *Stereum hirsutum* are reported to have been found in the Cape Province, on living trees of *Eucalyptus maideni*, which were more or less stunted. Sections through these trees showed disintegration of the wood accompanied by a clearly marked zone delimiting the activity of the fungus. The only previous record of parasitic action by *S. hirsutum* in South Africa was on *E. globulus* at Roodepoort, where the attack was attributed to weakness in the trees due to unfavourable cultural conditions.

Costantin (J.) & Dufour (L.). **Une maladie secondaire du Chêne causée par le Polyporus (Phellinus) rubriporus.** [A secondary disease of the Oak caused by *Polyporus* (*Phellinus*) *rubriporus.*]—*Comptes Rendus Acad. des Sciences*, clxxvii, 18, pp. 806–809, 1923.

The authors describe in some detail the characters of a disease caused by *Polyporus* [*Fomes*] *rubriporus* on a number of oaks (*Quercus robur*) in the Forest of Fontainebleau. The disease is restricted to a small strip, about 300 m. in length, in the vicinity of a footpath, and although it appears to be of long standing it does not seem to be extending. The trees attacked mostly grow in small groups originating from an old cut-down stump, from which the authors believe the infection to have started. For the most part the fructifications of the fungus are situated on the trunk quite close to the ground, but in one tree they were found up to 1·5 m. from the soil. In the wood of the trees attacked, cavities of very variable size were observed at various heights, sometimes up to 2 m. from the ground. The wood in the vicinity of these cavities was transformed into a powdery mass of a rather dark tobacco colour. The medullary rays are less affected than the parenchyma and vascular tissue. Infection takes place through wounds, and the progress of the disease is evidently very slow.

Phillips (J. F.). **Research : Indigenous forests. No. I. Disease in young natural regeneration of Olea laurifolia Lem.**—*S. African Journ. Nat. Hist.*, iv, 3, pp. 209–220, 1923. [Received 1924.]

The fungous parasites of *Olea laurifolia* [some general remarks on the life-history of which are given] in South African forests are discussed under two headings: (*a*) those prevalent in seedlings at the cotyledon stage: and (*b*) those occurring in the post-cotyledon stage up to 2 to 4 years of age.

A microscopic examination of the cotyledons of dead seedlings revealed the presence of black fungous bodies, probably belonging to the Microthyriaceae but not definitely identifiable on account of immaturity. In the stem tissues was a brown, thick-walled, septate, ramified mycelium, 3 to 4 μ thick, which occurred also superficially on the stem and roots.

Seedlings up to 2 to 4 years of age are subject to severe attacks by *Asterodothis solaris*, the stromata of which produce a dense, sooty covering on the upper surfaces of the leaves. Several seedlings, showing only traces of infection, were planted in a tin full of forest soil on 10th October, 1922; the stromata gradually increased in numbers until, by the following May, the leaves presented the usual sooty appearance.

Rhizoctonia [*solani*] (*Corticium vagum*) was found on the roots of diseased seedlings growing on heavy, badly aerated, and acid soil which is liable to periodical inundations and is overrun by weeds. The diseased condition is stated to be persisting in this area.

Pestalozzia (?) *hartigii* is believed to be responsible for a constriction of the stems of seedlings, but no conidia could be found.

In a general survey of the situation a serious deficiency in the intermediate large seedling and sapling stages is stated to exist in certain indigenous species of tree. Three major factors are held accountable for this phenomenon, namely, (*a*) sylvicultural errors; (*b*) fungous, bacterial, and insect diseases; and (*c*) unfavourable environment. A systematic investigation of fungous and insect diseases by a fully qualified forest pathologist is regarded as extremely desirable.

TOTTEN (H. R.). **Development of the fruit-body of a new parasitic Rhizopogon.**—*Journ. Elisha Mitchell Sci. Soc.*, xxxix, 1–2, pp. 101–107, 7 pl., 1923.

Rhizopogon parasiticus, Coker and Totten n. sp., develops parasitically on the roots of *Pinus echinata* and *P. taeda*. The fruit bodies average 2 to 5 mm. in diameter, though they may attain a size of 1·5 cm. They are usually lobed and convoluted, and are attached to one or more branching, flocculent, rhizomorphous fibrils which connect the fruit bodies on different roots. The colour of both mycelium and fruit body [the structure of which is described in detail] ranges from ochraceous salmon to warm buff. The fruit body arises from a thin flocculent weft of mycelium surrounding the succulent roots of the host and covering the lateral rootlets. These rootlets form a dense glomerulus of very short branches, around and in which the fruit body is produced. On reaching its full size the mass of rootlets is rapidly destroyed by the hyphae and its place taken by the gleba. The fungus first sends out single hyphae which force their way between the root cells, then, by repeated branching, a mycelium is formed which invades the tissue in solid sheets and completely destroys the cortex and xylem. After maturity the hymenium and then the entire gleba deliquesce, becoming a dark brown, tasteless slime with a faint odour of iodoform.

The systematic position of the fungus is regarded as obscure. It differs from most species of *Rhizopogon* in important characters, but is allied to *R. maculatus* and is therefore provisionally included in the genus.

R. parasiticus forms a compound ectotrophic mycorrhiza, but the mycorrhizal character is short-lived, and the mass of enclosed rootlets becomes completely absorbed. The fungus then forms its fruiting surface in exactly the position formerly held by the obliterated tissues of the host. In the literature on mycorrhiza [a summary of which is given] no reference has been found to this type of formation of fruit bodies. Wolf (*Journ. Elisha Mitchell Sci. Soc.*, xxxviii, p. 127, 1922) has shown that Tuckahoe or Indian Bread is formed by *Poria cocos* invading the pine root and producing a large sclerotium within it. Subsequently, under certain conditions, a poroid, resupinate fruit body is formed on the surface of the sclerotium. This is regarded as constituting a partial analogy with the fungus described by the author.

HANSFORD (C. G.). **Yams.**—*Journ. Jamaica Agric. Soc.*, xxvii, 10, p. 965, 1923.

A soft rot of yams [*Dioscorea batatas*], associated with an unde-

termined fungus having the characters of a *Pythium* or *Phytophthora*, has been reported. The fungus has been isolated and further studies are in progress.

LEHMAN (S. G.). **Pod and stem blight of Soybean.**—*Ann. Missouri Bot. Gard.*, x, 2, pp. 111–169, 5 pl., 7 figs., 6 graphs, 1923.

The disease of soy-beans attributed to *Phomopsis sojae*, of which the author has already published a preliminary account [see this *Review*, ii, p. 151], is more fully described. The perfect stage of the causal fungus has been developed in culture and proved to be a *Diaporthe*, to which the name *D. sojae* n. sp. is given.

Infection and dissemination of the fungus are favoured by high humidity. The most susceptible variety observed appears to be Black Eyebrow.

In culture the pycnospores germinate at hydrogen-ion concentrations ranging from P_H between 2·2 and 3 to beyond 8·6, the optimum being between 4·1 and 6·1. Changes in reaction of the medium occur during growth, cultures originally acid becoming less so and cultures originally alkaline becoming at first less, then more, alkaline. Light is essential to the formation of pycnidia.

GODFREY (G. H.). **Gray mold of Castor bean.**—*Journ. Agric. Res.*, xxiii, 9, pp. 679–715, 13 pl. (1 col.), 5 figs., 1923.

The present paper is a comprehensive review of the work done in connexion with the outbreak of a serious blight of the inflorescence of castor bean (*Ricinus communis*), caused by a new species of *Botrytis*, in 1918, when the plant was cultivated on a large scale in the southern United States as a war emergency measure. The perfect stage of the fungus (*Sclerotinia ricini* n. sp.) was found later and described by the author (*Phytopath.*, ix, 12, pp. 565–567, 2 pl., 1919). The disease was prevalent throughout the State of Florida and was also found in Mississippi, Louisiana, and Texas, in regions where the wet season regularly occurs in the summer time, a succession of several wet and warm days being necessary for the development and spread of the fungus. In the affected districts it destroyed from 10 to 100 per cent. of the crop, the losses being directly proportional to the amount of rainfall. In regions where summer rains were of brief duration and were followed by long spells of dry weather, the disease did not occur.

A detailed description of the symptoms is given. The trouble is a typical *Botrytis* blight. A heavy growth of a grey mould develops on the inflorescences in all stages of development, in many cases entirely destroying them; occasionally the leaves and stems are also attacked. During the winter and spring following the first outbreak abundant sclerotia appeared, first on the old inflorescences and later on the stems of the plants. The causal organism was readily isolated, as it grows rapidly on most of the usual culture media. About fifty isolations were made from different sources, mostly from single conidia. The fungus is characterized by its comparatively small, globose spores in dense heads, and the

constant dichotomous branching of the conidiophores; the appressoria are mostly microscopic; microconidia also occur.

In March 1919 apothecial stalks were found arising from the sclerotia in a few cultures. Single ascospores were isolated and germinated, and the connexion with the *Botrytis* stage was established. Later, apothecia were freely produced under artificial conditions, and were also found in the field. The perfect stage is a true *Sclerotinia*, smaller than the more common forms. Ascospores are discharged forcibly in a visible cloud when the apothecia are subjected to a sudden change from moist to drier conditions; they may germinate directly and produce a promycelium and hyphae indistinguishable from those of the *Botrytis* stage. Microconidia were also observed on germinating ascospores. The fungus, an English diagnosis of which is given, is homothallic. Freezing, drying, or an extended rest period of the sclerotia is not necessary for the development of the apothecia; the necessary factors are reasonably moist conditions, a temperature near the optimum (25° C.) for the vegetative growth of the fungus, sufficient air, and light.

Details are given of numerous inoculation, reisolation, and reinoculation experiments, most of which gave positive results, and in which strains from a single conidium or from one or more ascospores were used. Histological studies showed that the organism penetrated through the cuticle, as in the case of *Botrytis cinerea*, by a fine, peg-like projection from the point of contact of the developing germ-tube. After penetration, the fungus advanced quickly, and the disorganization of the host tissues was rapid and complete. The fungus was also found inside the caruncle and beneath the seed-coat of seeds attacked before maturity, and the sum of the evidence collected tends to show that the disease was brought to America from India with the seed. The fungus appears to be practically limited to the castor bean in its host range. Of a large number of other plants tested, only three other species of Euphorbiaceae and one species of *Pelargonium* were slightly infected, but promptly recovered under conditions that favoured a rapid spread of the disease on *Ricinus*. In the latter, some difference in varietal susceptibility was noted, the coarse ornamental varieties in general being more resistant than the commercial sorts. The author does not believe, however, in the possibility of controlling the disease on these lines. Extensive experiments also indicated that control by the application of fungicides, either in sprays or in dusts, was impracticable once the disease was well established. The spread of the disease from one locality to another could be prevented by treating the seed either with formaldehyde or mercuric chloride, by which it is not readily injured, and by submitting it to a floating process to remove all light-weight seeds. An effective control in the field can only be obtained by such measures as the use of clean seed and planting in land on which the disease has not recently occurred.

RHOADS (A. S.). **Notes on the failure of Grapevines to set fruit and on shelling.**—*Phytopath.*, xiii, 12, pp. 513–519, 1 pl., 1923.

The term 'coulure' is applied by French viticulturists to a con-

dition involving either the failure of vines to set fruit at all or to a shedding of the fruit when more or less fully developed. Hitherto this disorder, which is of considerable economic importance, has received but little attention in America, where the 'late coulure' or 'shelling', as the second phase of the trouble is sometimes called, is regarded as the more serious, whereas 'early 'coulure' or failure to set the fruit is, in fact, much the more important cause of loss.

Undoubtedly the chief cause of constitutional early coulure is the lack of self-fertility shown by certain varieties, believed to be an hereditary character and stated to be susceptible of remedy only by ringing the vines.

Of accidental causes the writer has made observations at Mountain Grove, Missouri, on two, namely, unfavourable weather conditions such as low temperatures and extremes of humidity, and fungous attacks during flowering. Losses due to rain at the blooming period varied in different varieties from less than one to eighty per cent. The losses from fungous attacks were chiefly due to blossom blight caused by *Guignardia bidwellii*, which on certain varieties destroyed from 5 to 75 per cent. of the potential crop. Late coulure is also due to a variety of causes connected with unbalanced nutrition and adverse climatic conditions, including overbearing, excessive vegetative growth, a superfluity of nitrogen, and possibly a deficiency of potash. Affected berries, which often exhibit a thickening and mottling of the skin with a brown zone immediately beneath the latter, generally fall two or three weeks before maturity. A typical 'shelling' may also occur as the results of attacks by several of the well-known parasitic fungi of the vine. This latter factor has not been adequately allowed for amongst the causes of shelling usually recognized, the term being generally restricted to loss due to supposedly pure physiological factors.

De Castella (F.) & Brittlebank (C. C.). **Oidium of the Vine. Uncinula spiralis (Berkeley & Cooke).**—*Journ. Dept. of Agric. Victoria*, xxi, 11, pp. 673–685, 11 figs., 12, pp. 738–745, 1923, and xxii, 2, pp. 98–108, 6 figs., 1924.

The origin, distribution, symptoms, and life-history of *Oidium* or powdery mildew of the vine (*Uncinula spiralis* [*U. necator*]) are described. The incidence of the disease is stated to be much less severe in Victoria now than twenty years ago.

Sulphuring when the vines are in flower has a very good effect on the setting of the fruit. In most cases a first sulphuring during the blossoming period, followed by others if necessary, should suffice to control the disease. In localities where *Oidium* is very prevalent, and on susceptible varieties, a preliminary preventive application should be given when the young shoots are 8 to 12 in. in length. Under Australian conditions scalding of fruit and foliage is apt to occur whenever the treatment is immediately followed by very hot, sunny weather, and in such cases the sulphur may be spread on the soil or crown of the vine, or applied in the early morning and evening, though high temperatures (104° F. or thereabouts) alone are generally sufficient to eradicate the disease. Vinifera varieties are

much less susceptible to sulphur injury than certain American species and their hybrids. Flowers of sulphur causes more severe scalding than ground sulphur, and is also apt to inflame the workmen's eyes, but the addition of lime or gypsum reduces the risk of injury. Sulphur should not be applied too short a time before vintage owing to the unpleasant flavour which it imparts to the wine.

The physical and chemical characters of the various forms of sulphur in use are discussed and directions are given for testing their purity. Detailed instructions are given for their application. Liquid sprays are only recommended for cool showery weather (temperature below 77° to 86° F.), which is rare under Australian conditions.

BURGER (O. F.). **Report of Plant Pathologist.**—*Ann. Rept. Florida Agric. Exper. Stat. for the fiscal year ending June 30, 1922*, pp. 45 R to 55 R, 1923. [Received 1924.]

The research work of the Department was mainly devoted to cultural studies of *Phomopsis citri*, the cause of stem-end rot and melanose of citrus. The former disease, which only affects ripe or nearly ripe fruit, was found to be accompanied by physiological changes in the host. Spraying experiments against *P. citri* were carried out with Bordeaux oil emulsion 3–3–50–1 [see this *Review*, ii, p. 364], and also for the control of scab (attributed to *Cladosporium citri*) which was prevalent on grapefruit, Satsuma oranges, rough lemon, and sour orange stock.

Phytophthora terrestris isolated from citrus seedlings badly infected with foot rot and grown in pure culture, produced the typical symptoms of the disease when inoculated into young trees. A similar experiment was conducted with *Phomopsis citri* and a species of *Diplodia* isolated from gumming citrus trees. In this case the symptoms produced by inoculation did not exactly correspond with those occurring in the field, but the organisms are believed to be capable under certain conditions of inducing typical gummosis [see this *Review*, ii, pp. 542, 543].

A severe outbreak of citrus canker (*Pseudomonas citri*), the source of which was obscure, occurred on young spring growth at Davie. Blossom-end rot (*Alternaria citri*), blight (cause unknown), die-back, wither-tip (*Colletotrichum gloeosporioides*), and scaly bark (*Cladosporium herbarum* var. *citricolum*) were all serious in certain localities. Blight appears to be most severe on the east and scaly bark on the west coast.

Avocados [*Persea gratissima*] were attacked by *C. gloeosporioides* and by a fungus morphologically indistinguishable from that causing citrus scab. *Pestalozzia* sp. was observed on diseased leaves.

Anthracnose of guava [*Psidium guajava*], due to *Gloeosporium psidii*, caused considerable losses, and a soft rot (*Rhizopus* sp.) was found on shipped guava fruit.

Loquats [*Eriobotrya japonica*] were seriously affected by blight (*Bacillus amylovorus*) and mildly by scab (*Fusicladium dendriticum* var. *eriobotryae*).

Mangoes suffered from anthracnose (*C. gloeosporioides*), dropping

of the blossoms (believed to be a physiological trouble), and die-back.

A species of *Cercospora* caused a severe blight of young mulberry leaves and twigs.

One of the commonest diseases of pecan nuts in Florida is scab (*Fusicladium effusum*). Anthracnose (*Glomerella cingulata*), *Hypochnus* sp., die-back (*Botryosphaeria berengeriana*), powdery mildew (*Microsphaera alni*), and rosette [see this *Review*, ii, p. 135] were also reported.

Red rot (*Colletotrichum falcatum*), mosaic disease, and *Sclerotium rolfsii* were all prevalent on sugar-cane.

Brown spot of maize (*Physoderma zeae-maydis*) was serious in the north of the State, while white blast (*Helminthosporium inconspicuum*), rust (*Puccinia sorghi* [*P. maydis*]), and root rot (*Fusarium* sp.) also caused considerable damage.

Cucumber plants sprayed with Bordeaux mixture for the control of downy mildew (*Pseudoperonospora cubensis*) remained green a fortnight longer than those not treated. Angular leaf spot (*Bacterium lacrymans*) caused damage to cucumbers in transit.

A strawberry disease involving desiccation of the leaves and stems caused much loss to the growers. *Sclerotium rolfsii* was isolated from one of the affected plants. Leaf spot (*Mycosphaerella fragariae*) also did considerable damage.

Numerous other records are given of the diseases of cultivated plants in Florida during the period under review.

WEBER (G. F.). **Field work in Florida during the year on disease control.**—*Quart. Bull. State Plant Board of Florida*, viii, 1, pp. 1–8, 1923. [Received 1924.]

Among other items of phytopathological interest the following may be mentioned.

Citrus canker [*Pseudomonas citri*] eradication work is still in progress owing to the occurrence of a few cases, the last in October 1923.

Damping-off (*Rhizoctonia* sp.) causes considerable trouble in citrus seed-beds. The fungus girdles the seedlings at the soil level, causing them to wilt and die. The trouble is partially controllable by sub-irrigation and frequent working of the soil round the stems of the plants.

The most recently observed disease of celery in Florida is pink root, believed to be due to a species of *Fusarium*. Experiments in its control by applications of sulphur and lime to the soil are in progress. Blackheart continued to prove highly destructive to this crop. It is believed to be due to some peculiar physiological condition connected with the soil, as both fungi and insects have apparently been eliminated as possible causes. Early blight of celery (*Cercospora apii*) was adequately controlled by spraying with Bordeaux mixture throughout the growing season. Copper-lime dust also gave good results when applied in the morning while the dew was still on the plants, but it was inferior to Bordeaux mixture except when used in excessively large quantities, the cost of which was prohibitive.

Coco-nuts, plumy coco-nuts (*Cocos plumosa*) and fan palms

(*Washingtonia robusta*) were attacked by a disease characterized by the wilting of the leaves one after the other until the crown falls off. It is apparently due to a species of *Pythium*, since this fungus has been most consistently isolated from the affected tissues.

Downy mildew of cucumbers and melons (*Pseudoperonospora cubensis*) caused very severe damage during the period under review, the losses in the former crop amounting to 50 to 70 per cent. Bordeaux mixture gave good control on the whole, but the rainy season was extremely favourable to the development of the disease and interfered with the action of the fungicide. Both downy mildew and anthracnose (*Colletotrichum lagenarium*) of cantaloupes were well controlled by Bordeaux mixture or copper-lime dust, while two applications of the former also sufficed to check *Bacterium lacrymans* on cucumbers.

Leaves of fig trees were attacked by rust (*Physopella ficus*) and leaf blight (*Rhizoctonia microsclerotia*), causing defoliation and eventual death of the trees. Both diseases were controlled by two applications, at a fortnight's interval in May, of 5–5–50 Bordeaux mixture. The untreated controls, which showed 20 to 40 per cent. of disease, were defoliated by the beginning of August, while the sprayed trees retained their foliage until October.

The plant pathologist, Dr. O. F. Burger, inspected the premises of a lumber company in St. Petersburg [Florida] which had lost thousands of dollars through the attacks of a fungus which was identified as *Poria incrassata*. The organism was found destroying sawed planks, floorings, piles, joists, window-frames, and building paper. The timber had to be re-sawn, a new concrete floor laid down, and the entire establishment disinfected.

Freeman (W. G.). **Administration Report of the Director of Agriculture, Trinidad and Tobago, for the year 1922,** 12 pp., 1923.

The following references (pp. 9–10) are of phytopathological interest.

The algal disease [red rust] of cacao, caused by *Cephaleuros mycoidea*, occurred with unprecedented severity, two outbreaks being reported from the margin of the central sugar-cane district and one from a neglected estate in the Northern Range. Serious losses from cacao pod rot (*Phytophthora* [*faberi*]) also occurred in consequence of the heavy rains in the latter part of the year.

Mosaic disease of sugar-cane has been considerably reduced, the number of healthy plots in the infested area being increased from 36 to 64 per cent. during the year. Complete eradication, however, is proving extremely difficult.

Intensive studies are in progress on the etiology of coco-nut bud rot, two devastating outbreaks of which occurred during the period under review.

Pole Evans (I. B.). **Report No. VI. Botany and Plant Pathology.** —*Journ. Dept. Agric. S. Africa*, vii, 6, pp. 550–552, 1923.

In connexion with the outbreak of potato wart disease [*Synchytrium endobioticum*] recorded in 1922 in Natal [see this *Review*, ii,

p. 10] considerable attention has been devoted both to preventing the increase of the area already known to be infected and to a search for further centres of infection. A close inspection failed to reveal any fresh outbreaks, and it is believed that the strict quarantine measures imposed on the two farms originally concerned were effective in checking extension.

No fresh cases of infection with citrus canker were found during the year, the inspection work being continued in the quarantined area.

Among other plant diseases under investigation may be mentioned an unrecorded rot in Jerusalem artichokes; the rot appears to originate in the ground at the points of attachment of the tubers and continues spreading after the latter have been lifted, sometimes involving almost the whole tuber. A fungus isolated from diseased tissues was found to resemble *Acremonium*.

McRae (W.). **Report of the Imperial Mycologist.**—*Sci. Repts. Agric. Res. Inst., Pusa, 1922–23*, pp. 53–60, 1923. [Received 1924.]

The sclerotial fungus discovered on rice plants in India in the previous year [see this *Review*, ii, p. 259] was shown by experiments to produce the leaf sheath symptoms already described and ultimately to cause the death of the plants. Inoculations on sugarcane gave negative results. The identity of the rice fungus with that causing 'djamoer oepas' of sugar-cane in Java has not yet been definitely established, though the morphological characters of both organisms appear identical in the sclerotial stage.

Foot rot of wheat causes considerable losses in Dharwar and the Central Provinces. A species of *Helminthosporium* isolated from diseased plants in both localities was found to be able to kill inoculated wheat seedlings. Species of *Acrothecium*, *Alternaria*, and *Rhizoctonia* are sometimes associated with it and their possible connexion with the disease is being investigated.

The application of sodium sulphate to jute plots was found to result in a large increase of yield and a decline in the incidence of disease [*Macrophoma corchori*: see this *Review*, ii, p. 360].

Strains of *Pythium* were isolated from various rotting Cucurbitaceae, including *Luffa acutangula*, *L. aegyptiaca*, *Trichosanthes anguina*, and *Lagenaria vulgaris*.

Wilt (*Fusarium udum*) of pigeon pea (*Cajanus indicus*) was extremely severe during the season under review. The results of manurial experiments indicate that superphosphate increases the incidence of the disease, while green manure causes a reduction. The addition of superphosphate to the plots already receiving green manure tends to counteract the favourable effect of the latter.

Petch (T.). **Report on the work of the Division of Botany and Mycology.**—*Ann. Rept. Ceylon Dept. of Agric., 1922*, pp. D 17–D 18, 1923. [Received 1924.]

The following items of phytopathological interest not previously noticed from separate publications may be mentioned.

Experiments have been begun with *Fomes lucidus* as the

probable cause of a root disease of *Hevea brasiliensis.* One case was reported in which *Polyporus mesotalpae*, known to cause a root disease of tea, was associated with *Hevea.*

A comparison of the black rot of tea [*Corticium* sp.] in Ceylon with specimens of *C. theae* from Java showed that the two fungi are distinct. A leaf disease of tea caused by *Phyllosticta theae*, known from the Caucasus, has been found in Ceylon. Certain stem diseases of tea and the 'thread blights' found in many parts of the tropics are being studied.

Investigations on Ceylon species of *Phytophthora* from various hosts have been continued.

SIMMONDS (H. W.). **Report of the Government Entomologist.**—*Ann. Rept. Fiji Dept. of Agric. for 1922*, pp. 3–5, 1923.

The following references of mycological interest are contained in this Report.

Bud rot of coco-nuts was very prevalent in the wet areas of Taveuni and Wainunu. Evidence was collected to show that infection (probably caused by *Phytophthora*) occurs primarily at the bases of the leaves.

The only tobacco disease observed occurred on very low-lying land at Tabia. It was characterized by a yellowing of the leaves, beginning at the base, and resulted in the eventual death of the plant. Hyphae of a fungus were found in the pith cavity extending upwards from the base.

BENSON (A. H.). **Report of the Director of Fruit Culture.**—*Ann. Rept. Queensland Dept. of Agric. & Stock for the year 1922–1923*, pp. 67–72, 1923.

A series of experiments was carried out in the coastal districts with a view to the control of the various gumming diseases of citrus, especially mal di gomma, and other pathological conditions, such as die-back, twig blight, exanthema, and the like. Very satisfactory results were obtained by the removal of the soil from the base of the tree, excision of dead roots and of gum spots down to the healthy wood, and the application to the exposed portions of Bordeaux paste. It was found that the exposure of the treated parts to sun and air had the effect of inducing a fresh growth of healthy bark. Drastic pruning of the tops of the trees was also practised, followed by spraying with Bordeaux mixture. The application of a complete fertilizer to depleted soils is recommended in conjunction with the above treatment.

Investigations on bunchy top of bananas [see this *Review*, ii, p. 372] are still in progress, so far with little success. Scarcely any new knowledge regarding the origin of the disease has been acquired since its first appearance in Queensland in 1915. In view of the great importance of the banana industry a nursery has been established in which it is hoped to propagate large numbers of young plants, raised from single eyes, in a healthy condition. The corms from which the eyes were obtained are first treated with corrosive sublimate and the eyes, when cut, immersed in formalin.

Brünnich (J. C.). **Report of the Agricultural Chemist.**—*Ann. Rept. Queensland Dept. of Agric. & Stock for the year 1922–1923*, pp. 28–31, 1923.

Five samples of soil were analysed in connexion with the occurrence of bunchy top disease of bananas [see preceding abstract]. One, from a plot where the disease was particularly severe, contained a great excess of magnesia over lime, had a high acidity and lime requirement, and only a very small amount (0·0076) of available potash. In an adjoining plot, where the fruit showed very little disease, the quantity of available potash was more than double that of the last. Two other diseased plots were poor in available potash, while in the fifth, where the bananas were in excellent condition, there was 0·03 per cent.

It would appear from these results that poverty of the soil is one of the contributory factors in bunchy top. Flowers of sulphur having been recommended as a remedy, the sulphur in the soil samples was also determined, but a sufficient amount was found in every case.

Botany and plant pathology.—*Ann. Rept. Iowa Agric. Exper. Stat. for the year ending June 30, 1922*, pp. 31–35, 1923.

Injury to maize seed by *Diplodia zeae* is of extreme importance in Iowa, resulting in a decrease in the stand which may amount to 25 per cent. The rag doll germinator was found to give inaccurate results as to the number of mouldy kernels. The fungus secretes a strong cellulose-destroying enzyme, which permits the hyphae to spread freely throughout the germinator in such a way as to cause the infection of sound ears.

Cucumbers from mosaic-infected vines were found to be worthless for pickling, owing to their failure to absorb the brine. In 1922 a severe epidemic of striped cucumber beetles [*Diabrotica vittata*] served to initiate the early occurrence and rapid spread of mosaic. Roguing out infected vines proved impracticable.

It has been shown that aphids, striped cucumber beetles, and mealy bugs act as carriers of the mosaic virus in the greenhouse. Investigations have shown that the mosaic of certain species of Cucurbitaceae, Leguminosae, Solanaceae, and Labiatae is interchangeable.

Raspberry anthracnose (*Plectodiscella veneta*) can be controlled by the following treatment: (1) lime-sulphur, 1 in 20, just before the buds open; (2) the same, 1 in 30, when the young canes are 8 to 12 in. high; and (3) the same as (2), just before the fruit turns black.

The following additional observations of phytopathological interest are referred to on pp. 43 and 46–47.

In connexion with the control of apple diseases, a comparison was made of the relative efficiency of Bordeaux mixture and lime-sulphur. The burning of the foliage by lime-sulphur is attributed to the oxidation of the sulphur and the formation of sulphuric acid. Laboratory experiments showed that sulphur dioxide was formed when lime-sulphur was heated to 115° F. Improperly mixed lime-sulphur and lead arsenate are stated to cause rapid decomposition of the chlorophyll in the leaves and fruit.

It was shown by a series of co-operative tests that crown gall [*Bacterium tumefaciens*] on nursery apple trees can be reduced by 15 to 20 per cent. by the treatment of grafts with 8–8–50 Bordeaux.

In the control of Illinois apple blister canker (*Nummularia discreta*) excellent results were obtained by the excision of the cankers with a heavy gouge and mallet, followed by the application to the wound of a mixture of white lead, raw linseed oil, and corrosive sublimate (½ oz. per 2 qt. paint).

RIKER (A. J.). **Some morphological responses of the host tissue to the crowngall organism.**—*Journ. Agric. Res.*, xxvi, 9, pp. 425–435, 6 pl., 1923. [Received 1924.]

In continuation of his previous investigations of crown gall (*Bacterium tumefaciens*) [see this *Review*, iii, p. 125], the author made a study of the morphological relations between the causal organism and its host.

The bacteria were consistently observed in an intercellular position in five series of inoculations on tomato stems which were examined at five-day intervals from the inception of the test until the development of distinct hyperplasia and hypertrophy and the formation of vascular elements. Associated with the presence of the bacteria was a change in the colour and staining reactions of the neighbouring cells, and in their power of double refraction of light.

The bacterial stimulus appears to attract the dividing nuclei to the adjacent part of the cell, thereby producing a disturbance of the cell polarity. The walls resulting from the early division were situated in the portion of the mother cell near the intercellular space containing the bacteria. Thus a small daughter cell is interposed between the bacteria and the remainder of the mother cell. The new tumour cells appear to form a sheath round the bacteria and to indicate the source of the stimulus. In the tomato this condition is most evident in galls eight or ten days after inoculation. In the later stages such a confusion of proliferating tissue frequently appeared that the original relationships were obscured. The younger galls seemed to be composed of groups of sheaths or strands of tumour tissue surrounding invaded intercellular spaces.

'Tumour strands' and 'secondary tumours' were secured only in about 5 per cent. of the inoculations, namely, when the inoculation puncture was made in the region of elongation close behind the condensed buds of such plants as sunflower, sweet pea, and tobacco. In the condensed buds of these plants the intercellular spaces were found to extend from the usual position of puncture up past as many as 15 internodes. Thus in all these plants the liquid released by a puncture might apparently flood the intercellular spaces for a considerable distance, when the subsequent expansion of the bud is taken into account, and the bacteria, migrating through the liquid, might involve the same amount of tissue. The elongation of the internodes in the condensed bud above the puncture is thus of extreme importance in the separation of the 'secondary galls' from the point of puncture [see also

this *Review*, iii, p. 16]. In the sunflower, galls apparently originating in this manner were found at a distance of 13 internodes and 49 cm. above the point of inoculation. A heavy inoculation of the growing region, however, prevented the expansion of the internodes.

No evidence was secured of the invasion of normal tissues by 'secondary tumours' and 'tumour strands'. The latter are merely a part of the 'primary gall' carried up by the elongation of the invaded region. The specialized tumour tissue of the 'secondary galls' apparently developed independently of any connexion with the 'primary galls', and did not necessarily simulate the characters of the latter.

NOWELL (W.). **Disposal of black pods and Cacao husks.**—*Empire Production and Export*, 85, Sept. 1923. [Reprinted in *Trop. Agric.*, lxi, 5, pp. 295–296, 1923.]

The following measures are recommended in connexion with the disposal of cacao husks and other material infected by pod rot [*Phytophthora faberi*]. The outer bark covering the infected area of the stem, when the latter is diseased at the point from which infected pods have fallen or been removed, should be excised and the wound painted with Bordeaux or Burgundy paste or a 5 to 10 per cent. solution of Jeyes' fluid. The practice of leaving diseased pods in heaps on the ground is responsible for a great amount of infection. All refuse should be buried in pits or trenches, or rotted down in pits with soil and lime and the resulting compost applied as manure. Cacao shells, where there is any risk of an admixture of infected pods, should not be used as a direct mulch.

Such measures as those outlined above should suffice to reduce pod rot infection to a minimum under normal conditions, but the control of the serious epidemics consequent upon continuous wet weather can only be effected by prompt and thorough spraying at high pressure.

ROUSSAKOV (L.). **Observations sur l'influence des conditions météorologiques sur le développement de la rouille des céréales.** [Observations on the influence of meteorological factors on the development of rust of cereals.]—*Rept. Intern. Conf. Phytopath. & Econ. Entom., Holland, 1923*, pp. 227–280, 1923.

After some suggestions as to the lines on which the study of the influence of meteorological factors on the development of rust in cereal crops should be conducted, the author states that his observations at Kamennaya Balka, south-western Russia, in 1921, led him to believe that too much importance is generally attached to the total rainfall during a given period, without taking into consideration the heaviness of the rains, their duration and frequency, and the time of the day or night when they occur. In that particular region rain in the morning or during the day has little influence on the disease, because the humidity of the air rapidly falls when it ceases; rain during the night is, on the contrary, very favourable for the spread of the infection. A long continued fall is also more conducive to infection than short storm showers. The disease

is greatly favoured by abundant dews. Temperature also plays a considerable part, and the influence of light does not appear to have been sufficiently appreciated, judging by the references in previous literature on the subject. Data are given in support of these statements.

CRÉPIN (C.). **Les rouilles du Blé, en 1923, à Grignon.** [Wheat rusts in 1923 at Grignon.]—*Rev. Path. Vég. et Ent. Agric.*, x, 4, pp. 318–323, 1923.

The year 1923 was marked at Grignon by a severe outbreak of yellow rust (*Puccinia glumarum*) on wheat as early as the end of March, instead of the usual date of its appearance in May or June. The disease continued almost up to the time of ripening, and towards the end of June severely attacked the ears; in many cases the diseased glumes were invaded and finally killed by semi-parasitic fungi (*Cladosporium herbarum*, *Heterosporium* sp.) with the result that the crop contained a high percentage of shrunken and misshapen grains. *P. triticina* and *P. graminis* were not very prevalent, and the author states that these latter two rusts are not considered to be dangerous in the neighbourhood of Paris, as they appear too late in the season to cause any serious damage to the crop. Notes are given on the relative resistance of several wheat varieties to rust.

BLARINGHEM (L.). **Notes sur la biologie des rouilles et des charbons. IV. Formes des rouilles d'automne sur les hybrides de Blés à végétation prolongée.** [Notes on the biology of rusts and smuts. IV. Forms of autumn rusts on Wheat hybrids with prolonged vegetation.]—*Rev. Path. Vég. et Ent. Agric.*, x, 4, pp. 308–313, 1923.

The author continues the description of the behaviour of a number of rare and new wheat hybrids bred by him, some of which were sterile and grew late in the autumn, in regard to infection with *Puccinia graminis* [see this *Review*, iii, p. 325]. He concludes that all hybrids of *Triticum monococcum* II with cultivated varieties exhibit during the whole of their vegetative life the same degree of susceptibility to the rust as the cultivated parent, and the same is true of crosses of *T. dicoccoides* with cultivated wheats. In fertile hybrids and on the straw of the sterile hybrids left to die on the root the predominating spore form found in the autumn was the teleutospore, while the sori on the still green shoots and leaf-sheaths only bore uredospores. The author believes that the production of uredospores or teleutospores respectively is not a function of the seasonal factor, but rather depends on the stage of maturity of the tissues attacked.

SCHITIKOVA (Miss A.). **Sur les moyens de combattre le charbon des céréales à l'aide des temperatures élevées.** [On the control of smut of cereals by high temperatures.]—*Rept. Intern. Conf. Phytopath. & Econ. Entom., Holland, 1923*, pp. 272–275, 1923.

Experiments on a small scale made by the author in 1920 and 1921 appear to indicate that loose smut of wheat (*Ustilago tritici*)

may be successfully controlled by hot air treatment of the dry seed at 60° C. for 24 hours, without impairing the germinative power. Thirty minutes treatment at 85° C. did not give promising results in reducing the incidence of the disease.

Blaringhem (L.). **Notes sur la biologie des rouilles et des charbons. III. Infection partielle par les Ustilaginées.** [Notes on the biology of rusts and smuts. III. Partial infection by Ustilaginaceae.]—*Rev. Path. Vég. et Ent. Agric.*, x, 4, pp. 246–252, 1 fig., 1923.

The author describes a series of observations of the delayed appearance of smuts on shoots that had sprouted after the main stem had completed its development in a perfectly healthy condition and had died down or been cut off. Amongst other plants, this was observed to occur in maize attacked by *Ustilago zeae* and barley with *U. hordei.*

He is inclined to think that in these cases the mycelium of the parasite was present in the host from an early stage, but that the conditions under which the latter grew in the first part of its life were such as to inhibit the development of the parasite, the latter completing its evolution only on the second growth late in the year.

De Jaczewski (A.). **Sur le développement menaçant du Tilletia secalis Kühn en Russie pendant les dernières années.** [On the threatening spread of *Tilletia secalis* Kühn in Russia during recent years.]—*Rept. Intern. Conf. Phytopath. & Econ. Entom., Holland, 1923,* pp. 267–272, 1923.

In a brief historical review, the author claims that *Tilletia secalis* Kühn, which was described for the first time by Corda in 1848 under the name of *Uredo secalis,* is the least widely distributed of the cereal smuts. In the second half of the last century three centres only of infection of some gravity were recorded in Central Europe, and from these the disease seems to have disappeared later. During the period 1877–1923 very little was heard of it, the only outbreaks known occurring in Bohemia in 1910, when it destroyed about 50 per cent. of the crop, and in Bulgaria, where it is considered as a dangerous parasite.

The first record of *Tilletia secalis* in Russia dates from 1884, and since then it has been reported at different times from widely separated areas in sporadic cases of no economic importance. In 1907 it was found seriously damaging the rye crop in a district of the government of Saratoff where it had been introduced with seed from the East. Adequate measures soon succeeded in stamping out this outbreak. In 1910 a new centre of infection was discovered in the government of Podolia in the south-west of Russia, about 90 per cent. of the crop being destroyed; the same year a few outbreaks of minor importance occurred in other localities, and from that time to 1915 the fungus was reported from year to year in various places, the damage caused by it remaining comparatively slight except in a few cases where about 40 per cent. of the crop was destroyed. From 1915 to 1920 information is lacking, but in the latter year the disease was again reported in

a mild form from western Siberia. In 1921 it reappeared in the same districts somewhat more severely and spread to the district of Tarsk, where 8·2 per cent. of the crop was attacked. Many samples of rye seed showed the presence of *T. secalis* spores. The author considers that the subsequent enormous distribution of the disease in Russia was probably due to the fact that all the seed was confiscated by Government, mixed together without treatment, and distributed for sowing throughout European Russia. In 1922 the infected area extended from the 60th degree of north latitude (neighbourhood of Petrograd) to the 44th (government of Stavropol) and reached the 21st degree of east longitude, the loss fluctuating from 1 to 50 or even 60 per cent.

The indications are that the disease is of oriental origin, and as far as has been observed it has spread from east to west. At present it appears to be becoming acclimatized in Russia, particularly in the centre, and a campaign has been started by the Phytopathological Service for treating with formaldehyde all the autumn-sown seed.

SAMUEL (G.). **Take-all investigations.**—*Journ. Dept. of Agric. S. Australia*, xxvii, 5, pp. 438–442, 1923. [Received 1924.]

An inspection of the comparatively new wheat-growing areas in the Pinnaroo district of South Australia, where the take-all disease [*Ophiobolus cariceti*] causes considerable damage, led to the conclusion that infection occurred most severely in crops following grass. The adverse effect of this rotation was mitigated by allowing a year of fallow to intervene between grass and wheat, especially when preceded by the burning of the former. It seemed reasonable, in view of these observations, to suspect the pasture grasses as carriers of infection, and two of the principal species, namely, *Hordeum murinum* and *Festuca bromoides*, were actually found to be attacked, the former severely and extensively. Perithecia were not observed but the characteristic plate-mycelium was present.

The following measures are suggested as likely to prove helpful in combating the disease: early burning of the stubble and fallowing after an attack of take-all; thorough cultivation and (if necessary) rolling of the seed-bed; the application to the soil of 1 cwt. superphosphate per acre (which has given good control of the disease on the west coast); the omission of pasture from the rotation in badly infected areas; and the sowing of early wheat in suspected soil.

DICKSON (J. G.), ECKERSON (SOPHIA H.), & LINK (K. P.). **The nature of resistance to seedling blight of cereals.**—*Proc. Nat. Acad. Sci.* [Washington], ix, 12, pp. 434–439, 4 diag., 1923. [Received 1924.]

Seedling blight of wheat (*Gibberella saubinetii*) has been found to develop only on plants growing at moderately high soil temperatures [see this *Review*, ii, p. 636]. Seedlings grown in the greenhouse at 8° C., and in the field when the mean soil temperature

is below 10°, are not affected. Above 10° the blight symptoms appear, and they increase rapidly in severity with rising soil temperatures up to 20° to 24°, reaching a maximum at the latter figure but being still severe up to 28°.

Seedling blight of maize occurs at 8° (at which wheat remains healthy) and is severe at temperatures of 12° to 16°, becoming milder from 16° to 24° and ceasing entirely at the latter temperature.

Lowering the soil moisture to a point where the normal metabolism of the seedling is inhibited predisposes both wheat and maize seedlings to attack by *G. saubinetii*. The disease occurs at all soil temperatures at which the plants grow, when the moisture content of the soil is reduced to 30 per cent. of the moisture-holding capacity.

The influence of illumination was also determined. At a soil temperature of 10° to 12° (critical for the production of blight) wheat seedlings grown under feeble illumination blight badly, whereas those exposed to a higher intensity of light and with a longer period of illumination each day remain healthy.

An important relation was found to exist between host-tissue composition and the development of infection [see this *Review*, iii, p. 253]. In wheat seedlings growing at low soil temperatures, the hyphae slowly penetrate between the cell walls of the tissues, whereas at the high soil temperatures direct and rapid cell penetration takes place. In maize seedlings this process is directly reversed.

Soil temperature and other environmental factors acting over considerable periods would seem to be more influential in determining predisposition to disease than brief exposures to extremes. Probably, therefore, blighting is associated with the growth responses of the hosts. The metabolism of germinating wheat and maize seedlings, as shown by microchemical and analytical chemical determinations, differs sufficiently at the various soil temperatures to account in a great measure for the difference in response of the two plants.

At low soil temperatures the starch in the wheat endosperm is hydrolysed much more rapidly than the protein. Under similar conditions of light and moisture but at higher soil temperatures (25° to 32°), both starch and protein are rapidly hydrolysed. At low soil temperatures wheat seedlings, separated from the endosperm, are high in sugars (15·5 per cent. at 8°, as compared with 11·9 per cent. at 28°). The dextrins in wheat are also highest at low temperatures (6·1 per cent. at 8°, as against 2·5 per cent. at 28°). On the other hand, at low soil temperatures maize seedlings, separated from the endosperm, are low in sugars (15·4 per cent. at 12°, as compared with 19·9 per cent. at 28°). The dextrins in maize are also lowest at low temperatures (0·8 per cent. at 12°, as against 2·2 per cent. at 28°).

The relatively high content of available carbohydrates in wheat seedlings at low soil temperatures and in maize at high ones results in thickened cellulose walls offering resistance to fungous penetration. No doubt this difference in chemical composition also furnishes a different medium for fungous growth when penetration does occur.

MacInnes (Jean) & Fogelman (R.). **Wheat scab in Minnesota.**—*Minnesota Agric. Exper. Stat. Tech. Bull.* 18, 32 pp., 9 pl., 1 map, 3 graphs, 1923. [Received 1924.]

Wheat scab appears to have become more prevalent in Minnesota, where the disease has been known for more than twenty years, since the introduction of the very susceptible variety Marquis. The trouble is apparently more severe in North America than in Europe or Australia, and it frequently causes heavy losses, which vary in extent from year to year, about 5 per cent. of the total crop having been destroyed in the epidemics of 1915 and 1919. While climatic conditions may have some influence on the prevalence of the disease, it is evident that scab is most severe in the maize-growing districts [see this *Review*, i, p. 10].

The symptoms are described. The principal agent of the disease is stated to be probably *Gibberella saubinetii* (Mont.) Sacc. (*Fusarium graminearum* Schwabe), an organism which is responsible for root, stalk, and ear rot of maize, and is capable of attacking a very wide range of hosts. These include barley, rye, and many grasses, but oats are only slightly susceptible. In inoculation experiments [which are described] this fungus caused seedling blight of flax, clover, tomato, radish, pea, and cucumber; stem rot of squash, bean, tomato, radish, pea, and sunflower; and rot of apples, carrots, and potato tubers. By inoculation it was also possible to provoke a root rot of bean similar to the one found naturally on maize. In wheat it causes a head blight and a seedling blight, the latter being as a rule indistinguishable from that caused by other fungi. Infection may occur through infected seed, infested soil, débris, and maize stubble, and the spores from these sources may be disseminated by wind, insects, or other carriers. Experiments have shown that *G. saubinetii* is capable of infecting uninjured heads of wheat, of producing definite spots on leaves of tomato and bean free from wounds, and of wilting a vigorous bean pod on the uninjured surface of which the inoculum has been placed.

It was found that the organism could live through the winter so long as the spores and mycelium were protected from the injurious effects of light. The optimum temperature for the growth of the mycelium is 25° to 27° C., at which spore germination is most rapid, and this agrees with observations in the field; at 3° and 33° growth is inhibited. Normal wheat seed germinates between 5° and 33°, the optimum being 25°. Scabby seed if germinated at either 10° to 15° or 30° to 33° C. generally produced healthy seedlings.

The only promising methods of control are stated to be: thorough winnowing and treatment of the seed, formaldehyde materially increasing the percentage of germination of scabby seed; rotation of crops, care being taken to avoid following maize by a wheat crop; clean cultivation in the fullest sense—grasses along the fences and roadsides are a source of danger and should be eradicated; early sowing, which may enable the wheat to grow away from the scab. The breeding of resistant varieties is, however, the surest means of preventing the disease. Preston and Haynes Bluestem, while much more resistant than Marquis, are not

now grown extensively. A resistant variety possessing other desirable agronomic characters is not yet known.

A list of 36 literature references is appended.

HYNES (H. J.). **Investigations by the late C. O. Hamblin into the Helminthosporium disease of Wheat.**—*Journ. & Proc. Roy. Soc. New South Wales*, lvii, pp. 160–172, 1 pl., 1923. [Received 1924.]

This paper has been compiled from the late Mr. Hamblin's original manuscripts of his work on the *Helminthosporium* foot rot of wheat in New South Wales.

The strain of *Helminthosporium* studied was isolated from Marshall's No. 3 wheat at Cowra Experiment Farm in November 1920, and from comparison with other wheat strains carried out in the United States it appears to be identical with *H. sativum* as isolated in Minnesota [see next abstract]. Cultures sent to Stevens were found to have shorter, thicker, and more oblong spores than the form studied by him [see this *Review*, ii, p. 59] and to be apparently a different sub-species or race. Comparisons with the Sudan strain [see this *Review*, ii, p. 61] showed the two to be closely similar.

The morphology of the Australian fungus is described. In culture it is at first whitish, then black and with an abundant production of spores. The latter are very variable in size, shape, and septation; those taken direct from affected plants measured 75 to 110 by 10 to 18 μ, tapered towards the apex, and had 0 to 11 septa. A small spore type (16·8 μ long) was isolated from Canberra wheat, while a form similar to the first isolation was obtained from *Bromus inermis* and another grass suffering from foot rot.

Details are given of a series of inoculations which established the pathogenicity of the 1920 isolation on Hard Federation wheat when the soil was kept moist. Leaf lesions, similar to those caused by *H. sativum* in America, were artificially produced, but were not observed under natural conditions in the field. Seed from diseased plants gave rise to healthy progeny, but the experiments are not regarded as conclusive, and it is thought that infection occurs either by adhesion of spores to the seed or by mycelial infection through the soil, or perhaps by both methods.

In 1921 spores of *Helminthosporium* were found at Cowra on Slav rye, suffering from a foot rot very similar to that of wheat, on Skinless barley, and on various grasses. Nearly all of the large number of wheat varieties growing in the experimental plots were found to be infected to a greater or lesser degree.

DOSDALL (LOUISE). **Factors influencing the pathogenicity of Helminthosporium sativum.**—*Minnesota Agric. Exper. Stat. Tech. Bull.* 17, 47 pp., 6 pl., 7 graphs, 1923. [Received 1924.]

After a brief description of the cereal disease caused by *Helminthosporium sativum* in Minnesota [see this *Review*, iii, p. 27], a detailed account is given of the physiology and pathogenicity of

a strain isolated from barley affected with foot rot and studied in single spore cultures.

Owing to the great variability in length of the spores it was found necessary to measure 500 to obtain accurate results. On potato dextrose agar significant differences in the mean length of the spores occur when the organism is grown at varying temperatures. The shortest spores, with a mean length of $55{\cdot}98 \pm 0{\cdot}35\ \mu$, were produced at 28° C., and the longest, with a mean length of $67{\cdot}32 \pm 0{\cdot}55\ \mu$, at 14°. The greatest differences in length were found between spores produced on different substrata. At 24° the mean length of the spores produced on potato dextrose was $65{\cdot}75 \pm 0{\cdot}37\ \mu$, on autoclaved ripe barley heads $67{\cdot}74 \pm 0{\cdot}38\ \mu$, and on green barley leaves $83{\cdot}14 \pm 0{\cdot}29\ \mu$.

A study of the temperature relations of the fungus showed that the mycelium grows at 1° to 37°, with an optimum near 28° C. Spore germination occurred in re-distilled water from 6° to 39°, the length of the germ-tubes indicating the optimum to be between 22° and 32°. The germ-tubes penetrated the coleoptile and leaf tissue at a range of 12° to 34°, severe infection and rapid development, however, occurring only between 22° and 30°. Above 30° the development of the lesions seemed to be checked, though they appeared shortly after inoculation. In general, it may be stated that rather high temperatures are most favourable to the growth of the fungus, spore germination, infection, and the development of the disease.

In phosphoric acid-potassium hydroxide solutions the spores germinated through a wide range of hydrogen-ion concentrations. A double optimum was observed, both maxima falling on the alkaline side of neutrality at P_H 8·2 and 9·2. In Czapek's solution without sugar the maximum germination took place at P_H 6 and 8. In general the spores are more tolerant of alkalinity than of acidity.

Leaf infection increases directly with the amount of moisture present, but root and foot infections seem to be most severe in extremely dry and extremely wet soils. No correlation was found between the fertility of the soil and the development of foot and root rot.

Experiments were conducted to determine the comparative ability of *H. sativum* isolated from Minnesota barley, *Helminthosporium* from stunted wheat in Illinois, and *Fusarium culmorum* from scabbed wheat to cause root and foot rot of Marquis wheat and Lion barley. Under the conditions of the experiment the strains of *Helminthosporium* caused more injury than *F. culmorum*, the Minnesota strain producing the greater amount of seedling injury on Lion barley and the Illinois strain resulting in more severe stunting of mature wheat and barley plants.

It is suggested that the widespread occurrence of *H. sativum* is explicable by its saprophytic response to such a wide range of environmental conditions; spore germination takes place almost irrespective of hydrogen-ion concentration or the prevailing temperature. In its parasitic form the fungus causes a somewhat restricted local infection, the amount of injury being determined largely by the number and size of the lesions. A direct correla-

tion was observed between the amount of moisture and the number of lesions. The maximum development of the disease may be expected at high temperatures in the presence of adequate moisture.

Root and foot infections are more severe in some soils than in others, but the differences are not sufficiently uniform or considerable to lead to any definite conclusion as to the influence of various types of soil, and they are probably largely due to variations in the soil temperature and moisture. In general the disease causes the most severe injury under conditions adverse to the growth of the host. Such factors as soil fertility apparently have little effect on its course.

CAMP (A. F.). **Citric acid as a source of carbon for certain Citrus fruit-destroying fungi.**—*Ann. Missouri Bot. Gard.*, x, 3, pp. 213–298, 1 pl., 21 graphs, 1923. [Received 1924.]

Using an improved technique [full particulars of which are given], the author studied a number of fungi parasitic on citrus with regard to their ability to utilize citric acid as a source of carbon.

It was found that none of the organisms throve on citrate as a sole source of carbon. Citrate mixtures adjusted to a suitable hydrogen-ion concentration, however, proved to be efficient supplementary sources of carbon, when used with small quantities of dextrose, for all the fungi tested except *Penicillium digitatum* and *Phomopsis citri.*

After a mycelial mat had been grown on dextrose, free citric acid was utilized readily by *Penicillium* sp., *P. stoloniferum*, and *Aspergillus* sp., and somewhat less so by *Sclerotinia libertiana.* Free citric acid was utilized slightly or not at all by mats of *Diplodia natalensis, Ph. citri, Alternaria* sp., *A. citri*, and *P. digitatum.* The response of the fungi in this respect was in agreement with their tolerance of hydrogen-ion concentration.

Curves representing the growth, trend of P_H, loss of dextrose, loss of carbon, and other features, are given for all the fungi mentioned above.

Acidic and alcoholic products were found to be formed under adverse environmental conditions, such as lack of O_2, unfavourable P_H, saturation with CO_2, and the like.

It is pointed out that the toleration or utilization of free citric acid is probably not an important factor in the specialized parasitism of *Ph. citri, P. digitatum, Alternaria* sp., *A. citri, S. libertiana*, and *D. natalensis*, but that it does very likely contribute to the destructive rotting of injured fruit by numerous fungi which cause their final collapse, e. g. *Penicillium* sp., *P. stoloniferum*, and *Aspergillus* sp.

A bibliography of 73 titles is appended.

CAMACHO (C.). **La agricultura de Tacna.** [Agriculture in the Province of Tacna.]—Tacna [Chile], 27 pp., 3 figs., 1923. [Received 1924.]

In this report on agricultural conditions in the Province of Tacna, Chile, by the director of the Plant Inspection Service,

reference is made to the gummosis of citrus trees, which is common in that region, and notes are given on the relative susceptibility to it of different species of *Citrus* together with recommendations for its control.

McRae (W.). **The operations against bud-rot of Palmyra Palms on the East Coast.**—*Agric. Journ. of India*, xviii, 5, pp. 487–500, 1 pl., 1923.

This is a brief historical review of the campaign started in 1906 by Butler and continued from 1910 by the writer for controlling the incidence and spread of the Palmyra palm bud rot (*Phytophthora palmivora*) [see this *Review*, iii, p. 270].

In the Godavari district the disease has been eradicated from or kept out of the uplands around the deltas, except for a short distance on the banks of the Godavari River and in two other small areas, while in the deltas it has been thinned out and reduced in intensity. In the Kistna district, which was infected to a lesser degree, the cases are confined to some isolated areas and infection is nowhere severe except in the riverside villages.

Reinking (O. A.). **Comparative study of Phytophthora faberi on Coconut and Cacao in the Philippine Islands.**—*Journ. Agric. Res.*, xxv, 6, pp. 267–284, 12 pl., 5 graphs, 1923.

The results are described of comparative studies of the organism causing bud rot of coco-nuts and black rot or canker of cacao, both of which result in severe annual losses in the Philippine Islands.

The evidence secured by the author's previous investigations (*Journ. Agric. Res.*, viii, p. 233, 1917) afforded adequate proof that the *Phytophthora* isolated by him from coco-nuts with bud rot was capable of producing the typical symptoms of the disease in injured coco-nut seedlings and trees, and also that the strain of *P. faberi* isolated from cacao could cause typical bud rot in coco-nut trees whether injured or uninjured.

The results of further inoculation tests have shown that uninjured coco-nut trees can be infected by pouring zoospore suspensions of the fungus into the bud, while various other members of the Palmae were also successfully inoculated by the stab method. Cross-inoculation experiments with strains of *Phytophthora* from diseased coco-nuts and cacao respectively resulted in severe infection by both strains on seedlings of soursop (*Anona muricata*), coco-nut, rubber, and cacao; fruit rot of papaw, tomato, apple, and cacao; tuber rot of potato; and vegetable blight of peas.

The physiological and cultural characters of the two strains of *P. faberi* were found to be identical in all particulars. The fungus grew well on various media, the optimum temperature for development being 27° to 30° C. Both strains were able to tolerate a wide range of hydrogen-ion concentrations, the optimum being P_H 7·4 to 7·8. Spore formation was somewhat impeded by darkness.

The results of a biometrical study of the morphological characters of *P. faberi* showed such extremely close agreement

in the measurement curves of both strains that no real distinction can be made between them. The identity of the causal organism in the two diseases, which is regarded as fully established, has a very important bearing on the work of control, especially in connexion with the common practice of interplanting coco-nut with cacao, a practice that should now be discontinued.

It is thought probable that some of the undetermined strains of *Phytophthora* on various hosts in the Philippines, including egg-plant, citrus, rubber, roselle (*Hibiscus sabdariffa*), and abaca (*Musa textilis*), are identical with that occurring on coco-nut and cacao.

COLEMAN (L. C.), VENKATA RAO (M. K.), & NARASIMHAN (M. J.). **Black rot or koleroga of Coffee in Mysore.**—*Mysore State Dept. Agric. Mycol. Ser. Bull.* 5, 12 pp, 4 pl., 1 fig., 1923.

The disease of coffee known throughout the south of India as black rot, and in Mysore as koleroga (a vernacular word meaning 'rot disease'), is caused by the fungus originally named *Pellicularia koleroga* by Cooke in 1876 and shown by v. Höhnel in 1910 to be a *Corticium* (*C. koleroga*). In 1913 Coleman independently discovered the basidiomycetous nature of the fungus in ignorance of v. Höhnel's paper. A translation of the latter is given and the description of the species amended in certain particulars. The basidia are shown to be single or at the ends of diverging branches, not in clusters of 2 to 5, the sterigmata are long (9 to 11·5 μ) not short, and the spores 8 to 9 by 3·5 to 4·5 μ instead of 10 to 12 by 4 to 4·2 μ as given by v. Höhnel. Dense clumps of hyphae of a sclerotium-like nature develop in the mycelial web on the leaves towards the close of the monsoon, and serve to carry the fungus through the dry season of the year.

Basidiospores are only formed during a brief period in the earlier part of the monsoon, their production in one case lasting only from 18th June to 6th July. The growth of the fungus is apparently entirely superficial, no evidence of its penetration into the host tissues having been found; it was, however, shown that the presence of the mycelium seriously interferes with the respiration of the leaves attacked, causing a reduction of 25 to 30 per cent. in respiratory activity, and it appears highly probable that the fungus also secretes an enzyme or toxin which attacks the living protoplasm of the host tissues.

Pure cultures of *C. koleroga* were grown from the basidiospores, but in no case were spores produced in culture. Attempts to infect coffee plants with these cultures resulted in a considerable growth of hyphae on the under surface of the leaves but without the production of typical symptoms, though a localized brownish discoloration developed.

The symptoms and range of distribution of the disease, which in India is limited to areas where the rainfall during the monsoon is almost continuous or the mist hangs and the air is heavily laden with moisture, are described. In areas with a rainfall below 70 inches it is rarely severe. Fresh infection usually appears two or three weeks after the break of the monsoon, and has been traced chiefly to old infected leaves hanging to or lodged in the bushes.

Spread from leaves remaining on the ground (except when blown on to the bushes) is doubtful and extension up the main stem has never been seen.

The same or a very closely related fungus was found in Mysore attacking at least seven other species of plants [a list of which is given] and in the case of one of these (*Jasminum* sp.) direct infection was traced from the plant to a coffee tree.

Control measures should consist in the removal of all diseased twigs and leaves by pruning before the break of the monsoon and in the digging in of the fallen leaves in badly diseased areas to prevent their being blown on to the bushes; as a preventive measure spraying with Bordeaux mixture, with the addition of resin soda or of calcium caseinate as adhesive, late in May or early in June is recommended.

BIRMINGHAM (W. A.) & HAMILTON (L. G.). **Diseases of the Cotton plant.**—*Agric. Gaz. New South Wales,* xxxiv, 11, pp. 805–810, & 12, pp. 877–886, 12 figs., 1923.

In these papers the principal physiological, bacterial, and fungous diseases affecting cotton in various countries are enumerated, briefly discussed, and illustrated, The only diseases recorded for New South Wales are anthracnose (*Glomerella gossypii*), a species of *Fusarium* similar to that responsible for boll rot, another *Fusarium* associated with a wilt of seedlings, and *Alternaria* leaf spot, causing a spotting of the leaves and bolls. The increasing importance of the cotton crop in New South Wales is stated to render precautions against disease extremely necessary.

KING (C. J.). **Habits of the Cotton root rot fungus.**—*Journ. Agric. Res.*, xxvi, 9, pp. 405–418, 8 pl., 4 diag., 1923. [Received 1924.]

Most of the information presented in this paper has already been summarized [see this *Review*, ii, p. 501, and iii, p. 134] but the following new points are of interest.

A characteristic symptom of root rot (*Ozonium* [*Phymatotrichum*] *omnivorum*) not hitherto described is the occurrence of the conidial mats exclusively in proximity to plants which have recently succumbed to the disease.

In the majority of fields inspected in the Salt and Gila River Valleys of Arizona, the amount of humus and organic carbon was less per surface foot of soil inside root rot areas than in adjacent healthy areas.

The rate of enlargement of regular circles of the disease in lucerne fields has been estimated at about 8 metres annual increase of diameter, whereas in cotton plantations the extension was calculated at 9 metres in 50 days.

Good results have been obtained in preliminary experiments on the control of the disease by promptly erecting dykes for the segregation of new centres of infection and saturating the soil around them with formaldehyde solution (1 part 40 per cent. formaldehyde per 100 parts water).

ARMSTEAD (DOROTHY) & HARLAND (S. C.). **The occurrence of mildew in black-bordered dhooties.**—*Journ. Text. Inst.*, xiv, 12, pp. T 475–T 481, 2 pl., 1923.

Cases of mildew were investigated in which the black border of 'dhootie' fabrics [such as are exported to the East Indies] produced black streaks and smudges when folded on the grey fabric.

The infection was found to be chiefly due to an *Aspergillus* of the *A. niger* group and a subsidiary *Penicillium*. The former grew most profusely under the black border, presumably owing to the more favourable water-content in that region, and the streaky discolorations referred to above were due to the abundant development of spores in the regions where the black border had been folded over on to the grey cloth. Fructifications were few or absent on the rest of the fabric, though mycelium was present throughout. On cloth with a water-content of 7·8 per cent. the *Aspergillus* developed moderately in 9 weeks; with 7·0 per cent. there was no development after 4 months; and with 14·8 and 15·5 per cent. growth was profuse after a fortnight.

As a result of atmospheric contamination incipient infection is stated to be present in practically all yarns and fabrics. Methods of prevention are discussed and the results of experiments with naphthol, thymol, naphthalene, and formalin described. All these substances imparted a considerable degree of protection against mildew but naphthol cannot be used commercially on account of its tendency to cause pink stains. Thymol and formalin were extremely efficacious.

The following recommendations for packing are made. The water-content of the goods should not exceed 7 per cent. and the containers should be hermetically sealed. A uniform temperature should be maintained on the voyage and on arrival in India. Preliminary treatment with formalin vapour might be given a trial. It is recognized, however, that the adoption of these recommendations would increase the cost of packing and their value can only be decided by practical experiments.

B[ERNARD] (C.). **Schimmels op Wespen (Rectificati).** [Fungi on wasps (a correction).]—*De Thee*, iv, 4, p. 125, 1923. [Received 1924.]

The fungus found parasitizing wasps in Java and erroneously identified with *Isaria sphecophila* [see this *Review*, iii, p. 412] is now stated by the Government Mycologist to be *Hirsutella saussurei* (Cooke) Speare [see this *Review*, iii, p. 335].

SCHOEVERS (T. A. C.). **Flax seed disinfection.**—*Rept. Intern. Conf. Phytopath. & Econ. Entom., Holland, 1923*, pp. 116–117, 1923.

In this brief communication the results are given of a series of experiments carried out in 1922 and 1923 in which flax seed infected with *Botrytis* and treated with various disinfectants was sown in small plots. The best results were obtained by moistening the seed with a 1 in 30 solution of germisan and rapidly drying it afterwards; no *Botrytis* appeared on the seedlings and 84 per cent.

of the seed germinated. Seed treated in the same way with a 1 in 30 solution of uspulun showed about 7 per cent. of *Botrytis*, the germination rate being the same as with germisan. The author states that the disinfection of flax seed on a large scale is difficult, as the mucilaginous layer in the seed-coat causes the seed to cake together and considerably reduces the germination.

BAILEY (D. L.). **Sunflower rust.**—*Minnesota Agric. Exper. Stat. Bull.* 16, 31 pp., 3 pl., 1923.

A detailed account of the morphology and life-history of the sunflower rust, *Puccinia helianthi*, is given.

In greenhouse experiments pycnidia appeared in 8 to 10 days after inoculation with teleutospores and were followed by aecidia in about the same time. Uredospores are produced in 5 to 7 days after inoculation with either aecidiospores or uredospores, and give place to teleutospores when unfavourable conditions of moisture or temperature affect the vitality of the host. Under certain conditions, which are not yet understood, there is a tendency for the rust to omit the aecidia and to develop uredospores two or three days after the production of pycnidia. The uredosori produced by this short-cycling had a very distinct appearance; they developed below the pycnidia and were confined to definite, light-coloured, and slightly hypertrophied spots.

Germination tests showed that although the majority of teleutospores require a period of rest, some may germinate immediately. Aecidiospores germinated very rapidly; freshly produced spores began to germinate within an hour, and within eight hours nearly all had usually germinated. Uredospores produced in the greenhouse germinated within an hour and a half, germination being best when floating in water, and very poor when the spores were immersed; an oil film on the cover slip of hanging-drop cultures increased the percentage of germination. Both teleuto- and uredospores germinated through a wide range of temperature (6° to 28° C.) with an optimum of 18°.

The teleutospores retained their viability for about six months; drying seems to be an important factor in determining the length of their resting period. The combined effect of various temperatures and relative humidities on the viability of the aecidiospores was tested; it was found that these spores do not remain viable for long and that throughout an extended range of temperature, humidity is much more important in affecting their viability than temperature. Uredospores were found to remain viable for at least six months when stored at from 8° to 23° C. and at from 20 to 40 per cent. relative humidity. This would suggest that uredospores may overwinter, a view which is supported by the fact that uredosori were found in the field early in the spring in the absence of aecidia.

The time required by the fungus to enter the host was determined by the influence on infection of different periods of incubation in moist chambers. For the uredo stage very heavy infection resulted from incubation during 24 hours, and some infection resulted after only 6 hours incubation; this indicates that infection can occur when there are only light dews. The incubation period of

the uredo stage was about two days longer in mature plants than in young plants. Light had a marked influence on the rapidity of the development of the rust; reduced light increased the length of the incubation period by about two days and a further reduction of the light intensity appeared to prolong it indefinitely. Temperatures below 50° F. inhibited the development of the rust, but when the inoculated plants were transferred to higher temperatures normal infection developed in from two to three days; higher temperatures do not appear to be a limiting factor, if moisture conditions are suitable, as the uredospores germinated at 30° C.

With regard to the biologic specialization of *P. helianthi*, which is known on at least 16 species of *Helianthus* but on no other genera, it was proved that the rust from four wild species (*H. scaberrimus*, wild *H. annuus*, *H. subrhomboideus*, and *H. maximiliani*) could readily infect *H. annuus*. Further tests with forms from cultivated and wild hosts revealed the existence of at least three, probably four, biologic forms of the fungus.

Experiments showed that the rust cannot be controlled, or its severity greatly modified, by the use of fertilizers; there are indications, however, that nitrates aggravate the defoliation caused by it. Spraying with Bordeaux mixture and dusting with copper carbonate powder proved altogether ineffective as a control measure in a single year's trial. It would therefore seem that in the development of resistant varieties of the host lies the only possibility of controlling the disease. Kaeurpher, a South American variety reported as resistant in Michigan, appears to be the only cultivated variety for which any resistance is claimed, and if it is found to be resistant to all the biologic forms of the rust, may be useful in the development of improved resistant varieties.

WARE (W. M.). **'Scorch' or Gloeosporium disease of red Clover.** —*Journ. Min. Agric.*, xxx, 9, pp. 833–836, 3 figs., 1923.

Scorch or anthracnose of red clover (*Gloeosporium caulivorum*), first reported in England in 1920 and recently investigated by Miss Sampson [see this *Review*, i, p. 422], occurred in a very severe form in the south-east of England in May and June 1923 on crops which had been considerably weakened by attacks of *Sclerotinia trifoliorum* during the preceding mild and damp winter.

The fungus causes narrow, dry depressions, $\frac{1}{8}$ to 3 or more inches in length, with black margins and lighter coloured centres, on the upright stems and leaf stalks of the clover. Small, white spore pustules occur on the lesions, which may extend to the pith. Ultimately the stem or leaf stalk may be partly or completely girdled, the upper part falling over and dying off. The clover field as a whole appears as though scorched, and the resultant crop of hay is of a very poor quality. In many cases fresh stems from the crown, which normally provide the second cut, grow up prematurely to replace the damaged first growth, the two being mown together.

The English broad red variety appears to be most susceptible to the disease, the Chilian and English cowgrass and English late-flowering red somewhat less so, and the so-called perennialized broad red and the Danish Hersnap almost immune.

The cultivation of resistant varieties offers the most promising means of control.

Section V. Fruit and vegetables committee.—*Dept. Sci. & Indus. Res., Rept. Food Invest. Board for the year 1922*, pp. 25–40, 1923. [Received 1924.]

The results of experiments on the cold storage of apples carried out at the Port of London and at Cambridge showed that, amongst the factors affecting the keeping qualities of the fruit, soil played a part, apples grown on silt being superior in this respect to those from fenland. The effect of the age of the tree on the keeping quality of the fruit was less marked, except in the case of apples from very young trees which, possibly on account of their large size and soft texture, did not last well in storage. The use of oiled wrappers [see this *Review*, iii, p. 215] prolonged the commercial storage life of Bramley's Seedlings by one or two months, both in cold store and in ordinary apple sheds. The striking efficacy of this method of packing was mainly due to the delayed appearance of spotting and surface disfigurement.

Internal breakdown [see this *Review*, iii, pp. 42, 145] was again found to be a more serious cause of loss in cold store at 1° C. than active fungous rots.

Lenticel spotting was very prevalent during the year 1921–22. In some cases the spots developed fairly rapidly into active rots which ultimately destroyed the fruit. Out of 74 isolations from lenticel spots 20 showed no trace of fungi, 14 yielded *Cladosporium herbarum*, 24 revealed the presence of known parasitic fungi, and 16 that of unidentified organisms. Evidently the lenticels were first disturbed by physiological causes, the active rots developing later. It is possible that the exosmosis of nutrient substances through the disorganized lenticel tissue supplies the fungous spores with the necessary stimulus to germination.

A number of Bramley's Seedling apples from four different localities, off different soils, and (in one case) from trees of varying ages, were periodically examined during storage for the presence of parasitic organisms. The results of this work are still incomplete, but the following preliminary observations may be given. Fen-grown apples were attacked principally by *Fusarium* spp. (chiefly *F. fructigenum*); unidentified fungi, *Penicillium* spp. (chiefly *P. expansum*), *Polyopeus* spp. (chiefly *P. purpureus* var. *verus*), also produced much active rotting, while damage was also caused by the *Fusicoccum malorum* and *Diaporthe perniciosa* group, *Pleospora pomorum*, and *Gloeosporium* sp. In apples grown on silt the *Fusicoccum* and *Diaporthe* group, unidentified fungi, and *P. expansum* caused most decay, while *F. fructigenum*, *Polyopeus purpureus* v. *verus*, and *Coryneum foliicolum* were also involved.

As a result of inoculation experiments in 1921 on apples stored at 1° C. 14 species of fungi were found to attack Cox's Orange Pippins while only 4 occurred on Bramley's Seedlings. In 1922 1,400 apples were inoculated with several strains of *Fusarium* of the *Blackmania* section [see below], *F. mali*, *F. acuminatum*, *Cephalothecium roseum*, and *Cladosporium*, and stored in two lots

at 1° and 15° C. All the forms of *Fusarium* and *Cephalothecium* attacked both varieties at the latter temperature.

A re-investigation of the physiological characteristics of the different forms comprised in the genus *Fusarium* has been conducted under accurately standardized conditions, with the result that a new section (*Blackmania*) of the genus, possessing certain distinctive morphological and physiological characteristics, has been established.

Various other aspects of the work of the Committee, chiefly relating to work still in progress, are described.

McClelland (N.) & Tiller (L. W.). **Apples in storage. Causes of flesh collapse.**—*New Zealand Fruitgrower*, vi, 4, pp. 209–210, 1924.

The preliminary results of a series of experiments in apple storage, which is in progress at the Cawthron Institute, Nelson, N.Z., showed an increase in the incidence of flesh collapse due to delayed storage of Sturmers. Thus mature fruit, the storage of which was delayed for 9 weeks, showed 91 per cent. of flesh collapse compared with 78 per cent. in that stored immediately, the corresponding figures for immature fruit being 92 and 57 per cent. The influence of the stage of maturity at which the apples were packed was examined in a separate series of experiments, and it was found that the percentage of collapse in fruit picked in three different localities was higher in mature and over-mature than in immature apples.

No evidence was obtained that the percentage of carbon dioxide in the three stores tested was a factor in inducing collapse, the highest percentage found being 1·5. The percentage in close-boarded and open cases was the same as in the surrounding atmosphere, and there was no 'settling out' of carbon dioxide within the stores. Ventilation frequently reduced the amount of carbon dioxide to 0·1 per cent. and perceptibly lessened injury from scald, possibly by removing esters produced in the store.

Overholser (E. L.), Winkler (A. J.), & Jacob (H. E.). **Factors influencing the development of internal browning of the Yellow Newtown Apple.**—*California Agric. Exper. Stat. Bull.* 370, 40 pp., 1 col. pl., 3 charts, 1923. [Received 1924.]

Internal browning [see this *Review*, ii, p. 268] is a non-parasitic disease of the apple flesh, which is particularly prevalent on Yellow Newtowns in the Pajano Valley of California.

In a study of the relation between orchard conditions and the development of this disease in storage, old trees bearing a light crop were found to be more severely affected than young, heavily bearing trees. Extremely vigorous and extremely feeble trees (especially the latter) appear to be more susceptible to the disturbance than individuals of normal vegetative vigour. The later the fruit was picked the higher was the incidence and the more rapid the development of browning in storage. The results of chemical analyses showed no connexion between the sugar and acid content of the fruit and its reaction to the disease, neither was any

relation found between the amount of browning and the P_H value of the expressed apple juice.

A reduction of the mean orchard temperature by about 5° F. during the growing season by shading a tree greatly increased the incidence of browning. After five months storage at 32° the crop from trees in unheated tents showed 50 per cent. fewer uninjured apples than that of adjacent trees normally exposed. Conversely, an increase of 10° in the mean orchard temperature by bagging individual apples in black cloth during growing markedly increased resistance. Fruit from the interior shaded portions of the tree browned twice as severely as that from the exposed portions where the temperature was 14° higher.

Delayed storage increased susceptibility to browning. No serious trouble occurred even after five months in fruit stored at 45° F. and above, while after six months at 40° the incidence of browning was so slight as to be of no commercial importance. At 36° about 65 per cent. of the apples showed browning by 1st April during each of the seasons for which records are available, while nearly all the fruit stored at 32° was affected by the same date or shortly after.

The accumulation of carbon dioxide was found to increase rather than lessen the resistance of the fruit to internal browning, while an increased supply of oxygen failed to control the disease. Ventilation and the use of wrappers impregnated with oils and waxes, which are good absorbents of essential oils, proved useful measures of prevention.

By measuring the electrical resistance of the apple tissue it was found that there is an increase of permeability prior to the end of the storage life of the apple, irrespective of the presence or absence of internal breakdown. It was further demonstrated that permeability was greatly increased by the application to the tissues of essential oils, e.g. amyl acetate, amyl valerate, acetaldehyde, even in very attenuated dilutions (0·001 per cent.). The resulting contact between the oxidase and tannins might well be a cause of browning.

Early harvesting would appear to be the first step in the control of internal browning, since fruit left on the tree until the cooler autumn weather sets in has been proved to be very susceptible. Storage at 37° to 40° F. or ventilation with a fan for 10 to 20 minutes twice a week if there are no facilities for maintaining a temperature above 30° should greatly assist in the reduction of the disease. The Yellow Bellflower, the only other commercial variety which flourishes in the Pajano Valley, is an autumn apple and therefore escapes browning by early consumption, but is inferior to the Newtown in quality, yield, and appearance.

DARNELL-SMITH (G. P.). **Russeting of Apples by Bordeaux mixture.**—*Agric. Gaz. New South Wales*, xxxiv, 11, p. 828, 1923.

A series of experiments was carried out at the Glen Innes Experiment Farm with Bordeaux mixture at concentrations of 3–4–50, 3–4–100, 3–6–50, 3–6–100, 3–9–100, 6–4–50, 6–4–100, and 6–2–50, in order to determine which strength produced the

least russeting. On Granny Smith, London Pippin, Buncombe, and Fameuse the best results were obtained with 3-4-100 Bordeaux mixture, the amount of russeting being negligible. With susceptible varieties, however, such as Dunn's (half the crop russeted with 3-4-100), Jonathan (two-thirds russeted with 3-4-50), and Cleopatra, a considerably weaker solution is advisable.

ARNAUD (Mme G.). **Sur un champignon parasite des branches du Poirier : le Dermatea corticola n. sp.** [*Dermatea corticola* n. sp.: a fungus parasitic on Pear branches.]—*Rev. Path. Vég. et Ent. Agric.*, x, 4, pp. 303-307, 1 fig., 1923.

This disease, which was found on pear trees in the neighbourhood of Paris, is believed to have been previously unrecorded in France. The bark on the branches and on the trunk was marked by a number of cracks and was separated from the underlying wood by a layer of cork, but did not show any tendency to peel off. Smaller branches were frequently killed, but on the larger limbs and on the trunk the progress of the disease was effectively checked by cork formation and rarely reached the cambium. Attacked trees apparently live for many years without suffering much injury, although the repeated formation of cork probably has a weakening effect. Externally the disease closely resembles that caused by *Sphaeropsis malorum* [*Physalospora cydoniae*].

The fructifications of the parasite, which appear as small dots under the slightly raised bark, are of three kinds. (1) Pycnidia somewhat resembling the acervuli of certain Melanconiaceae and containing large, hyaline spores which long remain unicellular. This form agrees with *Myxosporium corticolum*, described as the cause of a superficial bark canker in America. (2) A second pycnidial form develops as a hyaline stroma with more or less irregular cavities, containing rod-shaped spermatia ; in some fructifications stylospores and spermatia are contained in the same cavity, the former being located at the bottom of the pycnidium on a slightly convex base, while the latter arise from the lateral walls and in the upper portion of the pycnidium under the bark. (3) Later a stroma of a somewhat darker colour is formed among the pycnidia described above, and appears on the surface of the branch as a small, blackish-grey pimple. This develops into an apothecium, which is referred to the genus *Dermatea* in the broad sense of the word. The fungus is named *Dermatea corticola* n. sp. and a diagnosis in French is given.

ARNAUD (Mme G.). **Sur deux champignons parasites des Pruniers dépérissants.** [On two fungi parasitic on decaying Plum trees.]—*Rev. Path. Vég. et Ent. Agric.*, x, 4, pp. 346-350, 1 fig., 1923.

Plum trees growing in clay soil in the neighbourhood of Paris, where the vitality of the trees is depressed by the very dry summers which occasionally occur in that region, were found to be attacked by two fungi, namely, *Valsa leucostoma* and *Eutypella prunastri*. Usually both fungi attacked the extremity of weakly twigs, the death of which they accelerated, but cases were also found where vigorous branches, and even the trunks of young

plums, were attacked, the infection generally spreading downwards from a diseased twig or spur. When the fungi girdled the limb, the portion of the latter above the point of attack rapidly died; sometimes only a canker was formed in the first year, limited by a callus, but the following season the fungus generally grew beyond the callus and finally killed the limb.

Valsa leucostoma has two forms of fructification which are frequently found close together, namely, the *Cytospora* stage, consisting of pycnidia somewhat resembling lenticels, composed of a stroma with irregular cavities containing allantoid spores; and the perithecial stage consisting of perithecia grouped together in a pseudostroma which appears on the surface as a white protrusion marked by the black ostioles.

Eutypella prunastri has pycnidia resembling those of *Cytospora* but the spores are much more elongated and curved and are of the *Cytosporina* type; some authors have also recorded a *Cytospora* as the pycnidial form, and it is possible that the plum bears two closely related species. The perithecia are immersed in a stroma as in the other case, but have prominent beaks inclined towards the opening formed in the bark; the ostioles have four or five furrows easily distinguishable with a lens. The ascospores are similar to, but smaller than, those of *Valsa leucostoma.*

MAARSCHALK (H.). **Control of American mildew of Gooseberry by alkaline Burgundy mixture.**—*Rept. Intern. Conf. Phytopath. & Econ. Entom., Holland, 1923,* p. 119, 1923.

The author states that in Holland American gooseberry mildew is successfully controlled by spraying the bushes immediately after the fall of the petals with Burgundy mixture containing an excess of sodium carbonate (1·5 per cent. each of copper sulphate and [dehydrated ?] sodium carbonate). This treatment does not prevent the appearance of the disease, but it keeps the berries clean, and abundant yields have been secured in the past two years from plantations which the owners had intended to eradicate owing to the crops being practically entirely destroyed year after year by the mildew. No pruning of the gooseberry bushes is necessary during the winter.

COOK (M. T.). **A greenhouse disease of Melons.**—*Phytopath.*, xiii, 10, pp. 462–463, 1923.

A disease of muskmelons occurred in the winter of 1922–23 on trellis plants grown from English seed in a New Jersey greenhouse. The first symptom of the disturbance was a dead, brown streak extending in both directions along the stem and sometimes involving the leaves also. Pure cultures of a *Fusarium* resembling *F. vasinfectum* were obtained, but the question of its pathogenicity was not investigated. The organism is believed to have been present in the soil.

HANSFORD (C. G.). **The Panama disease of Bananas.**—*Jamaica Dept. of Agric. Microbiol. Circ. 1 of 23,* 28 pp., 2 pl., 1923. [Received 1924.]

The history, distribution, external and internal symptoms of

Panama disease of bananas, and the cultural characters of the causal organism (*Fusarium cubense*), are described with references to the work of previous investigators.

The spread of the disease in Jamaica is stated to be closely connected with weather conditions. Shortly after a rainy season the monthly agricultural reports show a marked increase in its incidence, with a corresponding reduction after periods of drought. According to Brandes (*Phytopath.*, ix, p. 339, 1919) this is due to the greater production of conidia in the wet weather, and to their inability to resist desiccation. Moreover, young roots, which are particularly susceptible to attack, are formed in large numbers during the rainy season. Plants previously infected succumb much more rapidly in wet than in dry weather.

The disease is unknown in the irrigated districts of Jamaica, Porto Rico, and Columbia, possibly owing to the intense heat of the surface of the soil in these districts, which would destroy the conidia of the fungus if present.

With a view to testing the assumption that *F. cubense* is present only in such banana soils as show evidence of the disease, isolations of *Fusarium* spp. from healthy plantations were made, and a number of strains were found that could not be distinguished from *F. cubense* in culture. Inoculations with these have so far given negative results.

Cases of Panama disease in Jamaica are treated by fencing off an area of 22 yards round the infected plant and destroying all the bananas and other crops within this space. There is ample evidence that labourers have spread the disease by entering these areas and digging up young banana and other suckers for their own use. The results of experiments in the destruction of healthy bananas in diseased areas by cutting them off at ground level and treating the rhizomes *in situ* with powerful poisons were unreliable, and it was found necessary to resort to the original method, that of eradicating the entire plant. Accumulated evidence [see this *Review*, iii, p. 121] shows that the quarantined areas cannot safely be replanted with bananas, the fungus apparently persisting indefinitely in the soil. It is, therefore, apparent that some new method of combating the disease, or of growing bananas in spite of it, must ultimately be discovered.

The so-called China variety is resistant to the Panama disease in Jamaica even when planted on heavily infected areas, while the Congo also appears to withstand the attacks of the fungus. Neither of these varieties, however, is suitable for commercial purposes on account of their poor shipping qualities.

The second part of the Circular gives a complete *résumé* of the legislation against Panama disease in Jamaica from 1915 onwards.

DARNELL-SMITH (G. P.). **'Bunchy top' in Bananas.**—*Agric. Gaz. New South Wales*, xxxiv, 12, p. 846, 1923.

Further investigations in the Tweed and Richmond River districts on the etiology of bunchy top of bananas [see this *Review*, ii, p. 372] have demonstrated that the disease is not due to degeneration of stock, while soil analyses fail to confirm the view that some essential constituent is missing. The incidence of infection appears

to have been somewhat minimized, but not yet controlled, by spraying the plants with kerosene emulsion for the control of aphids, which may assist in the transmission of the disease.

The author recommends that affected plants be removed and burnt at the earliest opportunity and the holes limed and not replanted.

BERNÁTSKY (J.). **Irrtümer und Missbräuche bei der Begutachtung der Bekämpfungsmittel.** [Errors and malpractices in the testing of disinfectants.]—*Rept. Intern. Conf. Phytopath. & Econ. Entom., Holland, 1923,* pp. 126–131, 1923.

Attention is drawn to the superficial and unreliable character of many of the verdicts pronounced (even by scientific men) on new methods for the control of plant diseases. The influence of environmental factors, including weather conditions and the stage of development reached by the parasite and its host, is stated to be frequently disregarded in the estimation of the value of a fungicide. In many cases, too, the methods of application and composition of the mixture are decisive factors in the success or failure of the treatment. There exists also a marked tendency for specialists to concentrate on one particular aspect of a plant disease to the exclusion of others, possibly more important, and the neglect of the most elementary precautions (removal of infected material, and the like) frequently invalidates the trials.

The following lines of investigation are suggested as appropriate for the testing of fungicides: a study of the relevant literature of the biology of the host and parasite concerned, and of the prevalent environmental conditions; the chemical and biological examination of the substance to be tested; and extensive laboratory and field trials, to which as much publicity as possible should be given.

Arising out of the discussion of this paper a Resolution was passed proposing the establishment of a Commission to consider the matter of the testing and examination of fungicides at the earliest possible date.

RIEHM (E.). **Vorschläge für eine einwandfreie Begutachtung von Pflanzenschutzmitteln.** [Proposals for perfecting the testing of preparations for the control of plant diseases.]—*Rept. Intern. Conf. Phytopath. & Econ. Entom., Holland, 1923,* pp. 131–134, 1923.

The necessity for the establishment in every country of 'official institutions for the testing and examination of fungicides' [see preceding abstract] is emphasized. Legal measures should be taken to exclude from commerce all preparations not officially sanctioned, and manufacturers should be required to produce guarantees that uniformity of composition will be maintained in their products. Testing operations should always be conducted under the supervision of an expert, and proper care should be taken in the selection of varieties for the trials, the arrangement of the experimental plots, and the like. The results of the experiments should be accurately presented and the data on which the final verdict on the preparation is based thus made available.

Dr. H. Faes [of the Lausanne Viticultural Station] made a sugges-

tion, in the course of the subsequent discussion, for a system of experimentation to be carried out by the central and provincial phytopathological institutes in every country.

Verhoeven (W. B. L.). **Testing of some new German seed-disinfectants.**—*Rept. Intern. Conf. Phytopath. & Econ. Entom., Holland, 1923*, pp. 120–121, 1923.

A series of experiments carried out to test the efficacy of some of the new German seed-disinfectants against stripe disease (*Helminthosporium gramineum*) of barley and bunt (*Tilletia tritici*) of wheat, showed that in the case of the first disease the best results were obtained with germisan, uspulun coming second, while segetan was entirely unsatisfactory. Against bunt germisan proved to be as good as copper sulphate and at the same time easier to handle. The formula recommended is a solution of 100 gm. germisan in 3 l. water per hectol. of seed.

Schmidt (E. W.). **Ueber die fungizide Wirkung von Teerfarbstoffen.** [The fungicidal action of coal-tar dyes.]—*Centralbl. für Bakt.*, Ab. 2, lx, 14–17, pp. 329–338, 1923.

A series of experiments was carried out on a number of fungi to test the toxicity to them of various coal-tar dyes. The results of a preliminary test of the effect of chinosol (0·01 per cent.) and methyl violet (0·01 per cent.) on *Trichothecium*, *Rhizopus*, and *Penicillium* growing in plum juice showed that development was absolutely inhibited in the methyl violet solution, while *Rhizopus* and *Penicillium* made extremely feeble growth with chinosol. In a further test which, in addition to the above-named fungi, included several species of *Aspergillus*, *Nectria ditissima*, *Monilia fructigena*, and *Fusarium* sp., both methyl violet (0·02 and 0·03 per cent.) and malachite green (0·01, 0·001, and 0·002 per cent.) exerted a strong inhibitory action. When growth occurred at all it was accompanied by characteristic malformations of the spores and mycelium. By exposing *Mucor mucedo*, *Rhizopus nigricans*, *Trichothecium roseum*, *Botrytis cinerea*, and *Alternaria* sp. to the action of brilliant green (0·002 per cent.) for varying periods from 10 minutes to 24 hours it was found that the different spores reacted quite differently to staining, the gradations of which are defined as *tinctio vitalis*, *tinctio praemortalis*, *tinctio mortalis*, and *tinctio postmortalis*, according as to whether staining occurred without injuring vitality, or was accompanied by injury or death, or only succeeded after the death of the spore. The addition of 0·005 per cent. brilliant green to six-hour-old cultures resulted in the production, after 24 hours, of *tinctio postmortalis* in *Mucor*, *tinctio mortalis* in *Botrytis*, and *tinctio vitalis* in *Alternaria*.

Comparative tests with brilliant and malachite green (0·001 per cent.) showed the toxicity of both to be approximately equal.

It was found that the degree of toxicity exercised by the dyes varied according to the spore-concentration in the test. Thus with *B. cinerea* at 1,000 spores per c. c. growth was completely inhibited in a solution of 0·005 per cent. brilliant green, whereas with 300,000 spores per c. c. feeble development was observed. The

time required for the killing of *Botrytis* spores (1,000 per c. c.) with a 0·01 per cent. solution of brilliant green was shown to be under four hours.

PATKANIANE (MISS A.). **Expériences sur l'emploi de la soude comme fungicide contre les Érisyphées**. [Experiments with soda as a fungicide against Erysiphaceae.]—*Rept. Intern. Conf. Phytopath. & Econ. Entom., Holland, 1923*, pp. 275–276, 1923.

Spraying experiments on *Alchemilla vulgaris* infected with *Sphaerotheca macularis* Magnus f. *alchemillae* with solutions of common and dehydrated soda showed that at similar concentrations this substance is more effective in checking the development of the mycelium of the fungus than polysulphides. The soda solutions, however, do not adhere well, and are soon washed off by rain, thus necessitating frequent applications. The addition of pulverized glass to the solutions with a view to increasing their adhesiveness appeared to lower considerably their fungicidal value.

STELLWAAG (F.). **Die Benetzungsfähigkeit flüssiger Pflanzenschutzmittel und ihre Messbarkeit nach einem neuen Verfahren.** [The moistening capacity of liquid plant protection preparations and its estimation by a new method.]—*Nachrichtenbl. deutsch. Pflanzenschutzdienst*, iii, 11, pp. 85–86, and 12, pp. 89–90, 1923.

None of the methods hitherto adopted for the estimation of the wetting power of liquid sprays has proved satisfactory, and the writer has accordingly devised a modification [which is briefly described] of one of the tests in common use, namely, the determination of the angle at which the liquid strikes the object to be treated. For thoroughly wetting liquids the angle is 0°, for sprinkling it is less than 90°, and for non-wetting liquids it exceeds 90°, no wetting at all taking place at 180°.

Since the preparations are generally mixed with water in certain definite proportions, the first step in the process of estimating their value is to gauge the wetting capacity of water on various portions of plants. On the upper side of leaves of Minister von Hammerstein and Charlamowsky apples the angles representing the moistening value of water were found to be 93° and 90° respectively, and on the under side 157° and 158°. On the upper side of old leaves of Riesling vines the angle was 94° to 95° when fresh and 115° to 120° when drooping, the corresponding figures for the under side being 150° to 154° and 155° to 160° respectively. On the upper side of sulphured vine leaves the angle was 93° to 94°.

The following values were obtained for certain direct-acting fungicidal preparations: 10 per cent. fructusan on apple bark, 18° to 20°; 5 per cent. carbolineum Nördlinger on apple bark, 26° to 29°; 1 per cent. solbar on apple bark, 90°, and on the under side of Riesling vine leaves, 162°; and lime-sulphur on the last named, 156°.

Of the indirect-acting protective preparations tested the angles for the upper side of Riesling vine leaves were 100° to 106°

with 1 per cent. Bordeaux mixture and 120° with 1 per cent. kurtakol.

The following values were obtained by the addition of various spreaders: medicinal soap (0·48 per cent.) on pear, 90° to 92°; ditto (1·2 per cent.) on pear, 90°; ditto (0·48 per cent.) on oats, 92°; ditto (1·2 per cent.) on oats, 90°; casein (0·02 per cent.) on pear, 90° to 92°; ditto (0·05 per cent.) on pear, 90°; ditto (0·02 per cent.) on oats, 160°; ditto (0·05 per cent.) on oats, 118°.

De Jaczewski (A.). **Résumé historique du développement de la phytopathologie en Russie.** [A historical summary of the development of phytopathology in Russia.]—*Rept. Intern. Conf. Phytopath. & Econ. Entom., Holland, 1923*, pp. 238–243, 1923.

After a short account of the development of phytopathology in Russia since the commencement of its study by Woronin about the middle of the last century, the author gives a sketch of the organization of the Russian Phytopathological Service of the present day. The purely administrative part is centred in the hands of a special section of the Central Administration of Agriculture, while the scientific direction rests with the annual Congress of Applied Entomology and Phytopathology, which meets towards the end of each year; the Congress has a permanent Bureau which supervises the carrying out of the decisions arrived at and prepares the agenda for the forthcoming meetings.

The Phytopathological Service proper consists of three different types of institutions. (1) A central institute of mycology and plant pathology represented by the Mycological and Phytopathological Laboratory of the Scientific Committee; its duties consist in centralizing all mycological and phytopathological literature, research work of a general nature on questions affecting the distribution of fungi and diseases of plants in Russia and the biology of the fungi, keeping type cultures for exchange with provincial laboratories, and training specialists. (2) Mycological and phytopathological research laboratories at the various provincial agricultural experiment stations for investigating diseases of a more local nature. (3) Plant protection stations with the practical mission of fighting outbreaks of diseases and pests, and of popularizing methods for their control. Financial stress does not allow of the establishment of all the stations planned, but their number is already fairly large, and it is hoped to increase it in the near future. Each station has a phytopathological and an entomological section which work on parallel lines but independently. Apart from these fixed stations the Administration of Agriculture organizes, in cases approved by the annual Congress, special missions to cope with particularly dangerous outbreaks; these did important work in the last few years in fighting plagues of locusts and rodents in the south-east of Russia and in Russian Asia, and this year a campaign is projected in Siberia and in certain parts of European Russia to attempt to check the growing menace to cereals from smuts by disinfection of the seed. Besides financial difficulties the work of the Phytopathological Service is considerably hampered by a serious lack of trained specialists.

Establishment of the International Committee of Phytopathology and Economic Entomology.—*Rept. Intern. Conf. Phytopath. & Econ. Entom., Holland, 1923*, pp. 214–216, 1923.

At the close of the International Conference of Phytopathology and Economic Entomology, held in Holland in 1923, Professor Mangin proposed the establishment of a permanent Bureau for the purposes of carrying into effect the decisions of the Conference and of making preparation for future meetings. The functions of the Bureau would comprise (*inter alia*) the centralization of literature connected with plant pests and diseases and appropriate control measures, and the indication of the necessary measures for co-ordination and the prosecution of researches already instituted. An important feature of the preparation for the next Conference would be the previous distribution to the delegates of a printed summary of the proposals intended to be made at the Conference, experience having shown that various misunderstandings have arisen from the discussion of matters the purport of which is not clearly understood. These objects would necessitate the levy of a small monetary contribution from each of the participating countries.

This proposal was accepted unanimously, and the first members of the Bureau, representing ten countries, were nominated to constitute the International Committee of Phytopathology and Economic Entomology.

Von Moesz (G.). **Die Pilzkrankheiten der ungarischen Medizinalpflanzen.** [The fungous diseases of medicinal plants in Hungary.]—*Rept. Intern. Conf. Phytopath. & Econ. Entom., Holland, 1923*, pp. 280–283, 1923.

The author announces the preparation by him of coloured plates representing 41 fungous diseases of medicinal plants, an annotated list of which is given. These plates are included in the exhibit of medicinal plants which has been placed in the Agricultural Museum in Budapest. Each is provided with an explanatory text.

Rankin (W. H.). **Raspberry mosaic and mosaic-free planting stock.**—*Proc. New York State Hort. Soc.*, lxviii, pp. 272–280, 1923.

The results of investigations on raspberry mosaic [see this *Review*, ii, p. 547] conducted in various parts of New York State in the summer of 1922 are described.

In plantings of the Cuthbert variety, the sparse, yellow foliage and thin growth of affected bushes are perceptible at a distance. Once mosaic appears in a row it soon spreads in both directions. Before the middle of June the leaves show large, irregular, convex, green blisters, with yellowish tissue between them. Later in the season a fine, yellowish, speckled mottling appears, except during very hot weather, when no symptoms at all are noticeable. The leaves on the fruiting canes are only about half the normal size. In the Perfection variety the mottling symptoms are much less distinct.

It was found, both in Canada and during the recent experiments in New York, that roguing gave excellent control of mosaic,

reducing infection to a minimum and almost entirely preventing the spread of the disease. Experiments are also in progress in the development of resistant varieties, and it is hoped that in a short time there will be an adequate supply of disease-free stock.

DEMETER (K.). **Ueber 'Plasmoptysen'-Mykorrhiza.** [On 'plasmoptysis' mycorrhiza.]—*Flora*, cxvi, 1 pl., 5 figs., 1923.

Studies on the endophyte with vesicles and arbuscles of the Apocynaceae and Asclepiadaceae were carried out at Munich from 1921 to 1923, *Vinca minor* being the plant chiefly investigated.

The endophyte enters through passage cells in the exodermis, infection occurring at any time of the year, but especially from March to May. Any part of the cortex as far as the endodermis may be occupied, no specific fungous region being apparent. Starch disappears from the infected cells.

The vesicles and arbuscles are described in detail. The latter are dendritic hyphae which, at a certain stage, show at the tips of the finest branches a mass of readily staining granules, which later on become distributed throughout the cell. These appear to be precipitations of albumin, set free by the rupture of the arbuscle-tips in consequence of free acids in the host cell sap. This 'plasmoptysis' is claimed to have been artificially effected in the endophyte in pure culture at an acid concentration of 0·025N HCl.

The sporangioles are the final residue of the resorbed fungus and consist mainly of the adhesive membrane, though they also yield certain albumin reactions of uncertain origin. They are completely amorphous.

The growth of the roots is impeded by the fungus, which apparently occurs in the soil only in the immediate vicinity of its host. In culture experiments in soil sterilized by heat the aerial organs of *Vinca minor* plants without mycorrhiza grew far more vigorously that those of infected individuals.

The number of communicating hyphae between the external and internal mycelium, in comparison with the intact root hairs, is small, and there is no likelihood of active absorption of nutrients by means of these hyphae.

The bearing of the author's observations on the various theories regarding the significance of mycorrhiza is discussed at length, and doubt is expressed whether the association can be regarded as a case of genuine symbiosis in the plants studied.

Using methods similar to those of Burgeff for the orchid endophytes a fungus was isolated from the roots of *Vinca* and *Vincetoxicum*. On certain media its appearance is almost indistinguishable from that of the orchid fungi, and it is therefore proposed to refer it to the genus *Rhizoctonia* as *R. apocynacearum*. It differs from the orchid mycorrhiza chiefly in its slower growth and uncommon variability in the morphology of the culture as a whole.

With this fungus sterile plants of *Vinca minor* were inoculated with the result that intracellular hyphae with sporangiole-like bodies developed. Intercellular hyphae were few, and the typical endophytic mycorrhiza of the vesicular-arbuscular type was not produced. [See also this *Review*, iii, p. 290.]

NOBÉCOURT (P.). **Sur la production d'anticorps par les tubercules des Ophrydées.** [On the production of antibodies by the tubers of Ophrydeae.]—*Comptes Rendus Acad. des Sciences*, clxxvii, 21, pp. 1055–1057, 1923.

The author's experiments made with pieces of tubers of *Loroglossum* (*Himantoglossum*) *hircinum* [Orchidaceae] placed on agar slant cultures of the endophytes *Orcheomyces psychodis* and *O. chloranthae* of Burgeff showed, in agreement with those made by Noël Bernard, that the development of the fungal mycelium was checked in the vicinity of the tubers by a mucilaginous substance exuded by the latter which stained the substratum brown. It was found that by previously heating the tubers at 55° C. for 35 minutes they lost this power of checking the advance of the mycelium, and the same effect was obtained by freezing the tubers at about 15° C. or by submitting them to the action of chloroform vapour. From this the author concludes that the fungicidal substance exuded by the tubers is not present in them at all times, but is a product of a reaction of the tuber cells to a toxin secreted by the fungus and must therefore be considered as a true antibody.

CAYLEY (DOROTHY M.). **The phenomenon of mutual aversion between mono-spore mycelia of the same fungus (Diaporthe perniciosa, Marchal). With a discussion of sex-heterothallism in fungi.**—*Journ. of Genetics*, xiii, 3, pp. 353–370, 2 pl., 2 charts, 1923.

A new phenomenon has been observed in the life-history of *Diaporthe perniciosa*, the cause of a rapid wilt and die-back of stone fruits [see this *Review*, iii, p. 217], namely, that of mutual aversion between certain monospore cultures of this organism when grown together on artificial media.

In some combinations of monospore cultures it was found that the resulting colonies grew across the plate and intermingled freely, while others showed a definite aversion, leaving a well-defined line of demarcation between the colonies. Since two pieces of mycelium from the same strain will meet when grown on the same plate (even though that strain may have shown aversion towards other strains) and since one colony on a plate can show aversion towards two other colonies which fuse, all three of which have been isolated from the same host, like must meet like and unlike repel unlike. The general appearance of the plates suggests the secretion of some possibly volatile toxin by the mycelia.

The results of the experiments described in detail in the present paper prove definitely that certain monospore strains are capable of completing all stages in the life-history of the organism and others not.

The work of other authorities on heterothallism and sex in fungi is briefly discussed.

DUCOMET (V.). **Sur la visibilité des symptômes de la mosaïque de la Pomme de Terre.** [On the visibility of the symptoms of Potato mosaic.] *Rept. Intern. Conf. Phytopath. & Econ. Entom., Holland, 1923*, pp. 39–43, 1923.

The influence of temperature and humidity on the symptoms of

potato mosaic is emphasized. Experience has shown that the symptoms are much more pronounced in damp seasons than in dry ones and in irrigated than in dry soils. The author's experiments indicate that of the two aspects of the disease, namely frisolée [puckering of the leaves: see this *Review*, i, p. 446] and mosaic [variegation], the former is induced by low temperatures and a dry atmosphere, while variegation appears under conditions of high temperature and humidity.

An instance is cited where potatoes planted in July became markedly affected with mosaic by the end of September, whilst others planted in April showed scarcely any symptoms, and the author suggests that the reason for this different behaviour lies in the greater humidity experienced by the former in the autumn.

Other experiments showed that on secondary shoots induced by pruning, mosaic symptoms were more conspicuous than on unpruned shoots.

The author thinks that seed selection would be facilitated by the addition of two tests to the usual diagnostic routine, namely pruning in the late season and experimental trial growth under glass in conditions most conducive to the manifestation of the mosaic symptoms.

QUANJER (H. M.). **General remarks on Potato diseases of the curl type.**—*Rept. Intern. Conf. Phytopath. & Econ. Entom., Holland, 1923*, pp. 23–28, 4 col. pl., 1923.

The author states that seven distinct types of 'degeneration' diseases of the potato may be recognized, namely leaf roll, marginal leaf roll, intervenal mosaic, aucuba mosaic, common mosaic, crinkle, and stipple-streak.

These are briefly described, and coloured plates illustrating them are appended. Leaf drop streak is also mentioned as probably belonging to this class of disease and it may be identical with the leaf drop described by Murphy [see this *Review*, i, p. 250].

GILBERT (A. H.). **Correlation of foliage degeneration diseases of the Irish Potato with variations of the tuber and sprout.**—*Journ. Agric. Res.*, xxv, 6, pp. 255–266, 6 pl., 1923.

It was found that, in severe cases both of mosaic and leaf roll, germination of the seed pieces and growth of the shoots are noticeably retarded. In the strains of Green Mountain under observation the same plants frequently exhibited both mosaic and leaf roll infection. All the plants from a single tuber and all the tubers from a single hill seem to show uniformity of behaviour in regard to these diseases.

Much variation in the progressive development of mosaic infection from year to year, possibly due to different strains of the virus, was observed in plants of known ancestry. Sometimes a condition of mild mosaic persists for several seasons, while in others the increased symptoms in succeeding years are very marked.

Spindling sprout of the tubers [see this *Review*, iii, pp. 296, 298] was found, in the varieties of potatoes investigated, to be a consistent symptom of leaf roll but not of mosaic. Net necrosis of the

phloem-necrosis type is correlated in the tubers with spindling sprout and appears to be a constant accompaniment of leaf roll. The necrosis symptoms, however, do not persist in the progeny tubers.

The yields of plants from spindling sprout tubers were much reduced as compared with those of plants from normal tubers, and hills exhibiting extreme symptoms of leaf roll gave far lower yields than those mildly attacked (normal 656·1 gm. per hill; mild leaf roll 262·9 gm. per hill; severe leaf roll and spindling sprout 91·8 gm. per hill).

No correlation was found between apical sprouting of the tubers and the health or disease of the plants.

WHITEHEAD (T.). **Transmission of leaf-roll of Potatoes in N. Wales during 1921.**—*Rept. Intern. Conf. Phytopath. & Econ. Entom., Holland, 1923*, pp. 147–149, 1923.

A diagram shows the method used by the author in 1921 and 1922 to study the transmission of leaf roll under farm conditions at Bangor, North Wales. Healthy and diseased potatoes were planted in alternating double rows, alternately in the same row, and alternately in the same row but with the roots separated by slates. It was found that leaf roll only passed from plant to plant in the same row although the foliage of adjacent rows was in close contact for many weeks. Transmission was very largely prevented by the partial isolation of the roots by means of the slates. No primary symptoms were observed in any of the healthy plants in 1921, and the yield was normal even when the plants by subsequent tests were found to have become infected, and although the yield of leaf roll plants was only 44·2 per cent. of the healthy plants in that year.

The conclusion is arrived at that in these experiments transmission took place through the soil and not aerially by means of insects. The author thinks the non-appearance of the symptoms in 1921 on plants which were found the following year to have become infected in that season is due to tubers only being infected and the virus not having reached the aerial parts. He also explains the slow spread of infection among plants grown in clay soils as compared with those grown in sandy soils on the basis of the soil transmission of the disease. It is suggested that the relative importance of aerial transmission by insects and soil transmission will vary according to soil and climatic factors.

Het vroeg rooien van Aardappelen voor pootgoed. [The early lifting of Potatoes for seed].—*Versl. en Meded. Plantenziektenkundigen Dienst te Wageningen* 32, 11 pp., 1923. [Received 1924.]

A summary of the work of Dr. O. Botjes in connexion with the early lifting of potato tubers [see this *Review*, iii, p. 100] is followed by a description of other experiments on similar lines. On 1st August 1922, 6,000 healthy plants from a field of Eigenheimers with about 20 per cent. of mosaic were harvested and another lot of 6,000 on 1st September. The tubers from both lots were planted in 1923, when the percentage of mosaic in those dug on

1st August was only 7 as compared with 29 in those harvested on 1st September.

In another test a number of healthy Eigenheimers were lifted in 1922 in a field with about 90 per cent. of mosaic. In 1923 the percentage of disease, according to the date of harvesting in the previous year, was as follows: 11th July, 1; 20th July, 4; 24th July, ± 6; 29th July, ± 15; and 3rd August, ± 30. Further experiments are briefly described in which the beneficial effect of early lifting is emphasized.

In conclusion it is pointed out that early lifting, valuable as it appears to be for selection and experimental purposes, presents considerable difficulties to the ordinary grower. Chief among these are the risk of heavy losses through premature harvesting and the inconvenience of storing large quantities of seed tubers. There are also cases on record in which the percentage of mosaic in the progeny of early-harvested tubers has been found to increase considerably (from 7 to 30 per cent. in one case) during the month elapsing between the first and second inspections.

Further investigations are considered to be necessary in order definitely to establish the value of early lifting in the control of mosaic and allied diseases.

VON BREHMER. **Die anatomischen und mikrochemischen Veränderungen des Kartoffelleptoms.** [The anatomical and microchemical changes of Potato phloem.]—*Rept. Intern. Conf. Phytopath. & Econ. Entom., Holland, 1923,* pp. 79–85, 2 pl., **1923.**

The results of a protracted study of potato plants affected by leaf roll have satisfied the author that three independent pathological conditions in the phloem, namely, necrobiosis, necrosis, and obliteration, have hitherto been regarded as a single phenomenon.

Necrobiosis, which occurs in all potato plants, healthy or diseased, is a process of swelling of the cells, generally beginning in the angles of the cells of the older portions of the phloem, near the bast fibres, and gradually extending to the younger tissues. The necrobiotic cells are not compressed, but the lumen diminishes gradually according to the degree of swelling, the cavity remaining roundish. The sieve-tubes, companion cells, and the parenchyma are affected. Necrobiosis is particularly marked under the stem 'wings', at the nodes, in the mid-ribs of the leaves, and in the phloem groups in the pith. The swollen walls consist of a mixture of cellulose, water, and slime, and give the same microchemical reactions as those of healthy tissues. In polarized light they appear homogeneously luminous.

Quanjer's phloem-necrosis [see this *Review*, ii, p. 569] does not originate in the angles of the cells, though these may be involved, but at random in various parts of the phloem. Affected cells collapse, the nuclei becoming corroded and the cytoplasm shrinking. All that remains is an irregular lumen, bounded by a ruptured or indented thickened wall, or, as the result of pressure from adjacent cells, a prominent, asymmetrical, serrated fissure. The affected tissues are yellowish-brown, and the thickening of the walls ceases after the early stages and is never so pronounced as in

necrobiosis. Necrosis appears to occur preferably in necrobiotic tissues, as though its cause finds a suitable medium for development in the swollen cell walls, and in such cases the discoloration and other symptoms mentioned above are developed much more rapidly than when necrosis begins in normal tissues.

Detailed notes on the use of certain reagents for the detection of necrosis are given, and it is stated that the contents of the necrotic cells are more acid than those of the normal tissue.

The author's investigations support Quanjer's view of a correlation between phloem-necrosis and leaf roll.

Obliteration of the phloem tissue is a typical phenomenon of senescence, which occurs only in dying organs. The entire tissue is more or less uniformly thickened and is tangentially or radially compressed. The sieve-tubes show marked signs of collapse, the fissures typical of necrosis, however, being absent. The conducting cells and cortical parenchyma are also affected. Obliteration may begin at any part of the tissue which has evacuated its contents and no longer serves for the transport of material. [The statement in this *Review*, ii, p. 571, second paragraph, that 'obliteration' is an infallible symptom of leaf roll was due to a misprint, 'lignification' being the word intended.]

EASTHAM (J. W.). **Some Potato disease problems in British Columbia.**—*Scient. Agric.*, iv, 3, pp. 89–94, 1923.

The most important fungous diseases of the potato in British Columbia are discussed.

Common scab (*Actinomyces scabies*) occurs wherever potatoes are grown, even when the tubers have been carefully disinfected and planted in virgin soil. The writer was recently informed of a case in which potatoes had been grown from the seed ball sown in leaf mould, and scab was present on the tubers. Such observations, though not based on scientific experimentation, raise doubts as to the accuracy of present knowledge concerning the distribution of the scab organism.

Late blight (*Phytophthora infestans*) appears to occur in an epidemic form only in the Lower Fraser Valley and at fairly long intervals.

The two principal species of *Fusarium* causing storage rots appear, from limited observations, to be *F. caeruleum* and *F. trichothecioides*, the latter being the chief Dry Belt form.

The Superintendent of the Dominion Experimental Farm at Invermere states that he has almost eliminated leaf roll by sprouting the seed tubers before planting and rejecting all that showed weak sprouts, although the disease is very prevalent in the surrounding district.

Mosaic is common and widespread, particularly severe cases having occurred on Sea and Lulu Islands. One reason why irrigated country is no longer considered equal to the natural rainfall belt in seed production is the prevalent belief that mosaic may be masked under such conditions and develop when the seed is planted elsewhere.

Black scurf (*Corticium vagum* var. *solani*) [*C. solani*] and *Fusarium* wilt are also described.

WOLLENWEBER (H. W.). **Krankheiten und Beschädigungen der Kartoffel.** [Diseases and pests of the Potato.]—*Arb. Forschungsinst. für Kartoffelbau*, 7, 56 pp., 20 pl., 1923.

The macroscopic and microscopic characters of the principal fungous diseases, physiological disturbances, and insect pests of the potato are figured and described. The various types of scab are differentiated [see this *Review*, i, p. 183], and the relative importance of the diseases, together with brief methods for their control, are indicated in most cases.

AJREKAR (S. L.) & KAMAT (M. N.). **The relationship of the species of Fusarium causing wilt and dry rot of Potatoes in Western India.**—*Agric. Journ. of India*, xviii, 5, pp. 515–520, 1 pl., 1923.

The authors claim to have established through their infection experiments [some details of which are given] on potato tubers in the laboratory, that in Western India dry rot of potato tubers and wilt of potato plants are caused by two different species of *Fusarium*, which differ in spore measurements, form of growth, and temperature relations in pure culture. They further state that the dry rot *Fusarium* seems to agree with *F. caeruleum* and that of the wilt with *F. radicicola* more nearly than with *F. trichothecioides* and *F. oxysporum* respectively as previously suggested by Nagpurkar and Kulkarni.

AJREKAR (S. L.) & RANADIVE (J. D.). **The relative responsibility of physical heat and micro-organisms for the hot weather rotting of Potatoes in Western India.**—*Agric. Res. Inst. Pusa, Bull.* 148, 18 pp., 3 pl., 1923.

The authors conducted a series of experiments in an attempt to determine the relative part played by high temperatures and by micro-organisms in the storage rot of potatoes which was described by Mann, Nagpurkar, and Joshi under the name of 'heat rot' [see this *Review*, i, p. 358] and attributed by them to the effect of physical heat alone. The rot was also said to be a variation shown in the Italian white round potato of the condition described as 'black heart' by American workers, but a comparison of the descriptions of the symptoms is held by the authors to disprove this assertion. The experiments [some details of which are given] showed conclusively that high exterior temperatures (up to 42° C.), acting continuously on potato tubers of the Italian variety for a period of at least nine days cannot cause the 'heat rot' symptoms in the absence of micro-organisms; these symptoms occurred only when fungi (*Sclerotium* and *Fusarium* spp.) and bacteria were present and were then produced even at temperatures between 16° and 22° C. It was also found that apparently sound tubers may harbour the rot-producing organisms and that the latter may often escape sterilization when the tubers are steeped for 30 minutes in a 2 per cent. solution of copper sulphate or for two hours in a 0·1 per cent. solution of corrosive sublimate; these fungicides, therefore, cannot be entirely relied upon to prevent rotting in storage.

As the optimum limits of temperature for the development of the bacteria and fungi associated with 'heat rot' are between 20°

and 37° C., it appears desirable to reduce the temperature of storage to at least 20° C. to ensure freedom from potato rots.

PAINE (S. G.). **'Internal rust spot' disease of the Potato tuber. (Synonyms: sprain, net necrosis, Eisenfleckigkeit, Kringerigheid, Buntwerden, and maladie des taches en couronne.)** —*Rept. Intern. Conf. Phytopath. & Econ. Entom., Holland, 1923*, pp. 74–78, 1923.

Of the internal rust spot disease of the potato tuber, which the author thinks is no doubt the same as has been described under the various names given above, two separate types are distinguished. In type 'A', which in England and Ireland has hitherto been known as 'sprain', the storage tissue of the tuber is spotted with islands of corky tissue of a reddish-brown colour up to 0·5 cm. in diameter, which may break at the centre to form cavities; in type 'B', known in England and America as 'net necrosis', fine strands of corky tissue of a dark brown or chocolate colour run for considerable distances through the tissue, frequently radiating from the pith to the vascular ring and appearing to follow the lines of the internal phloem, although they are not necessarily confined to the latter.

The causal organism first isolated by the author in 1917 [*Ann. of Appl. Biol.* v, p. 77, 1918] is named by him *Pseudomonas solaniolens* n. sp. There are two strains. One (which was only isolated five times) is a small, oval, non-sporing rod, motile by a single very long polar flagellum, and possessing a penetrating smell of earthy potato. It grows readily on all the ordinary culture media and produces on gelatine a very striking iridescence when viewed by transmitted light. Gelatine is not liquefied and the colonies are round. The other strain (the one usually isolated) is without odour, slightly larger, more coccoid, and non-motile, growing more rapidly in cultures, and producing spreading colonies on the surface of agar or gelatine, but both forms are physiologically identical and seem to be equally virulent in the laboratory. After prolonged culture, especially in the sugar broths, the smelling strain has passed into the non-smelling one.

Inoculation experiments are described. Though the results have not been uniformly successful, this is thought to be due to the technique employed. The local infection produced at the point of inoculation, however, shows symptoms of disease which cannot be distinguished macroscopically or microscopically from those of the disease of type 'A', and in a few instances symptoms resembling those of type 'B' have been produced. It is not clear, however, why the same organism should act on the tissue in these different ways.

LÖHNIS (MARIA P.). **On the resistance of the Potato tuber against Phytophthora.**—*Rept. Intern. Conf. Phytopath. & Econ. Entom., Holland, 1923*, pp. 174–179, 1923.

A study was made of the resistance to *Phytophthora infestans* of Dutch and foreign potatoes cultivated for comparative purposes on sandy and clay soil. Cultivation of the fungus on raw sterile potato blocks and on the tubers of 28 varieties showed no correla-

tion between the degree of extension of the mycelium in the parenchyma and that of resistance to the disease. Further tests of the exterior parts of the tubers, however, showed that in the resistant Bravo (and possibly also Neuer Markt) variety the property of resistance resides in the boundary layer of cork and parenchyma. No anatomical differences in this region were found between the resistant Bravo and the highly susceptible Eigenheimer. The rate of wound cork formation was also identical in the two varieties, as well as in the susceptible Blauwen, when the tubers were kept at the same temperature. The cells of the boundary layer of Eigenheimer stained more deeply with $CuCl_2$ than those of Bravo, so that the resistance of the latter cannot be due to a higher tannin content. Some physiological difference probably exists which cannot yet be explained. No correlation was observed between the degree of thickness of the cork, which generally ranged from 8 to 14 cells, and resistance in the field.

The results of comparative field inoculation tests on Eigenheimer tubers grown respectively on clay (155 tubers) and sandy (158 tubers) soil showed a much higher degree of infection in the former case, the number of diseased lenticels per tuber sometimes amounting to 100 as against a total of 13 in the whole of the tubers of the latter. On staining the material with Sudan III it was found that the lenticels in the tubers grown on clay were filled with unsuberized parenchyma cells, while those in the tubers from sandy soil were covered with layers of suberized cells. The author suggests that in the behaviour of the lenticels is to be found the chief explanation of the differences in the degree of resistance against *P. infestans*.

DUCOMET (V.). **Sur une maladie de la Pomme de terre nouvellement observée en France.** [A Potato disease newly observed in France.]—*Rev. Path. Vég. et Ent. Agric.*, x, 4, pp. 324–325, 1923.

In this brief note the author records a somewhat severe outbreak in 1923 on the 'Saucisse' variety of potato in the department of Creuse of *Cercospora concors* (Casp.) Sacc., a fungus previously found by him on the Early Rose variety in the Dordogne in 1910. In the earlier attack only the basal leaves were affected and no appreciable loss was caused, but in the present outbreak the young leaves also were involved. The author calls attention to this disease, which may be more widely spread than generally thought, as macroscopically it can easily be confounded with *Alternaria solani*.

SCHOEVERS (T. A. C.). **X-organisms in diseased Spinach roots.**—*Rept. Intern. Conf. Phytopath. & Econ. Entom., Holland, 1923*, p. 116, 1923.

Dr. J. Franchini, to whom the author showed his slides and photographs of the so-called X-organisms discovered by him in diseased spinach roots [see this *Review*, ii, p. 54], was quite sure that these bodies are protozoa and has expressed his readiness to examine the author's material. The organisms are exactly like an

organism recently studied by Dr. Franchini, as was apparent from a photograph produced by the latter.

KASAI (M.). **Cultural studies with Gibberella saubinetii (Mont.) Sacc. which is parasitic on Rice-plant.**—*Ber. Ōhara Inst. landw. Forsch.*, pp. 259–272, 1923. [Received 1924.]

Two types of fusariose are known to affect rice in Japan, one being due to *Lisea fujikuroi* Sawada and the other to *Gibberella saubinetii*, with which the author's investigations were exclusively concerned.

The conidial stage of *G. saubinetii* has been identified in Japan as elsewhere with *Fusarium roseum*, but von Thümen (Die Pilze der Reispflanze, p. 3, 1889) regards them as distinct species, and in any case the latter is a collective species doubtless including *F. graminearum*, which is now recognized as the form connected with *G. saubinetii*.

Epidemic invasions of *G. saubinetii* have fairly often been observed and their field characters described in Japan on wheat, barley, oats, and other cereals. Since 1920 the author has given special attention to the head blight and node rot of rice and carried out cultural experiments with the fungus.

G. saubinetii attacks rice in at least three different ways. The first pathological condition results from the infection of germinating seeds in irrigated seed-beds as described for wheat by Miss Doyer [see this *Review*, i, p. 56]. When infected grains are exposed to moisture before or after sowing, a considerable percentage are attacked by the fungus and the resulting seedlings destroyed.

The second condition is known as scab or head blight. Minute, mouldy, white (later yellow, then salmon or carmine) spots appear on the surface of the husks. These are the sporodochial masses of conidia, which are generally confined to a limited area of the grain but may cover the entire surface of the husk. Infected grains are light, shrunken, brittle, and incapable of germination.

Miss Doyer's description (*loc. cit.*) of node rotting of wheat is equally applicable to the third form of rice infection by *G. saubinetii*.

The perithecial stage was obtained on rice meal agar and potato cultures (at room temperature) of *Fusarium* conidia from rice grains. The physiological characters of each separate culture are described in detail. In one of the successful cultures the potato slices turned salmon pink in seven days; sections were found to be covered with plectenchymatous stromata formed by interwoven mycelia. The latter consist of chains of swollen cells with a thick membrane and brown or red, highly vacuolate contents.

Culture experiments with the ascospores of *G. saubinetii*, obtained either in the field or in culture and kept at a temperature of 25° and 30° C., resulted in the production of the conidial stage. The colour of the mycelium ranged from pink to a deep pomegranate purple. The connexion between *G. saubinetii* and the conidial form, which was identified as *Fusarium graminearum*, was thus determined. Wheat and barley heads inoculated with a water suspension of ascospores of *G. saubinetii* from rice developed the typical symptoms of blight.

The hyphae on or near the surface of the medium are generally yellow or purple in colour, those more remote being hyaline. The colouring-matter is formed within the cells of the hyphae and does not diffuse into the medium. *G. saubinetii* produces a carmine coloration on alkaline media and yellow in the presence of acid. In 1922 Hopkins, in a private letter to the author, stated that 'in cultures with a reaction P_H 4·0 and those more acid [the pigment] is yellow, at P_H 4·7 and in cultures more alkaline it is red or lavender, while at P_H 4·4 it shows an orange colour.' The results of the author's own tests of the solubility of the pigment in a number of solvents are briefly described. Alkaline blue perithecia of the fungus were found to turn red or brown on the addition of acids and this alternative change of colour can be produced repeatedly.

A bibliography of 39 titles is appended.

KEUCHENIUS (P. E.). **Ervaringen uit de praktijk der bruine bast bestrijding.** [Experiments in the practice of brown bast control.]—*Meded. van het Plantation Res. Dept. der U. S. R. P. Inc.*, 4 pp., 1923.

The author's method for the control of brown bast, an account of which has already been published from another source [see this *Review*, i, p. 263], is stated to be in general use on various large rubber estates in the Dutch East Indies and to have been recently officially recommended by the A. V. R. O. S. Experiment Station.

VAN OVEREEM (C.) & STEINMANN (A.). **The red-root disease of Rubber trees in Java caused by Ganoderma ferreum (Berkeley).**—Reprinted from *Arch. voor de Rubbercult*, vii, 10, pp. 453–460, 4 pl., 1923 in *Trop. Agric.*, lxi, 6, p. 370, 1923.

Red root disease of *Hevea brasiliensis* is extremely widespread in western Java, where it also attacks a wide range of other cultivated and wild plants, including tea and cacao. The chief symptom of the disease, which is prevalent in plantations 10 to 12 years old, is a dying-off of the tree tops, the crowns becoming stag-headed and the leaves yellow. Infection originates in stumps of trees left in the ground after felling, and is spread by the roots, the exterior of which is covered with dark red (later purplish-black) strands.

The disease was originally attributed to *Poria hypolateritia*, a fungus which has never been reported in Java. The fructifications of the Java species have now been found, and the fungus is identified as *Fomes ferreus* (*Ganoderma ferreum*). The cause of the disease in Malaya is stated to have been attributed to *F. pseudoferreus* Wakef. The fructifications only appear on the collar of the root at an advanced stage of the disease, and this fact, together with the early removal of infected trees, may account for their having been overlooked.

Remedial measures should include the removal of stumps, thorough drainage, liming, the burning of affected roots, disinfection with carbolineum, and subsequent tarring.

Bateson (E.). **Annual Report of Mycologist and Agricultural Adviser for 1922.**—*Supplement to the Official Gazette, State of North Borneo*, pp. 80–82, 3rd December, 1923.

Parasitic diseases of rubber were comparatively mild during 1922. *Fomes* [*lignosus*] and pink disease [*Corticium salmonicolor*] were relatively unimportant, partly owing to vigorous treatment in the past, and partly to the number of new plantings which have not yet reached the susceptible age.

Black thread [*Phytophthora* sp.] and mouldy rot [*Sphaeronema* sp.] caused little damage, but claret-coloured canker [*Phytophthora faberi*] is becoming more widespread and may well prove extremely dangerous in the future. *Ustulina* [*zonata*] and *Poria* occurred only sporadically.

Brown bast was also much less prevalent than formerly, probably owing to the substitution of alternate-day for daily tappings.

Pinching (H. C.). **Rubber in Burma.**—*Bull. Rubber Growers' Assoc.*, x, 12, pp. 647–655, 1 diag., 1923.

The following diseases of rubber (*Hevea brasiliensis*) were noted by the writer during a recent visit to Burma.

Fomes pseudoferreus was found affecting a few old trees, while *Ustulina zonata* occasionally occurred after attacks of white ants. On the whole, however, root diseases appear to cause remarkably little damage in Lower Burma and are readily controllable by appropriate treatment.

Sphaerostilbe repens lives chiefly as a saprophyte on tree stumps left lying about after thinning. The disagreeable odour of timber affected by this organism was very noticeable on some estates. Trees pollarded prior to thinning out and thinned out stumps should not be allowed to remain long in the plantations, especially during the south-west monsoon, as they permit the fungus to accumulate.

Abnormal leaf fall was extremely prevalent in neglected areas and on poorly developed trees. Its cause, like that of pod rot and black thread canker, is believed to be *Phytophthora meadii*. No direct means of control are known, but the incidence of the disease may be largely reduced by thorough sanitation. The black thread canker has greatly decreased since the cessation of tapping during the south-west monsoon. The establishment of nurseries is much hampered by the prevalence of pod rot, few pods escaping attack. Patch canker (*P. faberi*) was found on most estates.

Pink disease (*Corticium salmonicolor*) caused some damage on the younger areas, but was kept well in check on the whole. The application of a disinfectant (e. g. tar) is recommended as a substitute for the removal of affected branches during the rainy season, when it is difficult to carry out the latter operation successfully.

The incidence of brown bast has greatly declined since the introduction of alternate-day tapping. Stripping and scraping operations were successfully performed on some of the older estates.

Arrhenius (O.). **Några bidrag till kännedomen om sambandet mellan markreaktionen och vissa kulturväxters utveckling. Orienterande försök.** [Some contributions to the knowledge of the connexion between soil reactions and the development of certain cultivated plants. Preliminary experiments.]—*Medd. Centralanst. för försöksväsendet på jordbruksområdet* 245, 13 pp., 1 diag., 1923.

Experiments were carried out at the Stockholm Agricultural Experiment Station in 1922 to define the relationship between soil reaction and plant growth. The various plants tested were grown in soil adjusted to different concentrations of hydrogen and hydroxyl ions by means of sulphuric acid or sodium hydroxide.

Excessively acid or alkaline reactions (P_H 3 and 4 and P_H 9 and 10) resulted in damage to the root system and consequent stunting of the plants. This phenomenon appeared in the various plants tested at P_H concentrations which are given in each case. Chlorosis was observed in many of the plants at certain acid and alkaline concentrations sometimes similar to, sometimes differing from, those that caused root injury.

Yellow tip disease of oats [see this *Review*, i, p. 417], believed by Danish authorities to be due to excessive acidity of the soil, was not once observed and may, therefore, presumably be attributed solely to nutritional disturbances. Grey speck disease of oats [see this *Review*, iii, p. 24] does not appear to be correlated with an excessively alkaline reaction; its incidence actually declined on alkaline soils. On the other hand, bright speck of sugar beet [see this *Review*, i, p. 421] increased in proportion to the degree of alkalinity in the soil.

Certain parasitic diseases that affected the plots, e. g. black and crown rust of oats [*Puccinia graminis* and *P. lolii*], and yellow rust and mildew of wheat [*P. glumarum* and *Erysiphe graminis*], appear to have no connexion with the soil reaction.

The practical application of the data secured by these experiments is discussed at some length, and various suggestions are made for the utilization of acid- or alkaline-tolerant plants in soils of known reaction, and for the production by breeding or selection of strains of crop plants suitable for growth under such conditions.

Hudig (J.). **Diseases of crops on alkaline and sour soils.**—*Rept. Intern. Conf. Phytopath. & Econ. Entom., Holland, 1923*, pp. 136–141, 2 pl., 1923.

Coinciding with the extensive applications of artificial fertilizers in Holland during the last twenty years there has been a steady increase in the so-called 'Veenkoloniale' or 'reclaimed moor' disease of oats. The first symptom of the disease appears suddenly as a yellowish discoloration of the seedlings, irregularly distributed on the leaf blades of which are minute, greenish-grey spots. The leaves droop, frequently forming a crack or fold where they bend. The tops of the blades often remain healthy long after the middle has withered. In mild cases the affected plants

may recover to some extent, but a reduction in yield always results.

Rye, potatoes, beets, mangolds, and turnips (in the order given) are also somewhat susceptible, clover, peas, and beans being more resistant. The withered spots occurring on cereals are not found on the other affected crops, which merely exhibit a mottled chlorosis and diminution of turgor.

The results of experiments have shown that the disease may be controlled by the use of acid fertilizers, e.g. peat, moss, starch waste, superphosphate, potash salts, and ammonium sulphate. All alkaline substances, including lime in various forms, basic slag, and nitrate as a basic salt, should be avoided.

It was shown in a series of pot cultures in pure sand (98 per cent. SiO_2), the soil reaction being regulated by a mixture of the nitrates of sodium and ammonium, that the reaction itself is not the primary cause of the disease but only the principal guiding factor. The primary cause must be sought in microbiological factors. The disease never occurs, for instance, on chemically pure sand, but is constantly associated with the presence of small quantities of organic matter, such as cellulose, dextrose, glucose, saccharose, starch, or humified sugar. Ground oat leaf blades, however, unless containing 60 per cent. of cellulose, appear to favour normal growth.

Manganese sulphate at the rate of 50 kg. per hect. [recommended also for the control of grey speck: see this *Review*, ii, p. 403] has been shown to effect a remarkable improvement in the condition of susceptible crops. The actual soil reaction was not changed, its alkalinity in some cases even being intensified (up to P_H 10).

The new so-called 'Hooghalen' disease, which may be considered as the direct opposite of the foregoing, appears to have arisen largely from the effects of excessive applications of acid fertilizers. The order of susceptibility is also in an approximately inverse sequence: Leguminosae, beets, rye, oats, potatoes. Affected plants become yellowish-green but exhibit no diminution in turgor. The leaf blades of cereals (especially oats and wheat) show a striping resembling the skin of a tiger. In rye the leaf blades fail to unfurl, often keeping the younger leaves tightly enclosed. The disease may be controlled by the application of such substances as lime, calcareous material from industrial refuse, nitrates, and basic slag.

The 'black peat' disease, believed to occur exclusively on reclaimed moorland and heath soils, and apparently affecting only oats and rye, causes chlorosis and a diminution of turgor, but without the withered specks typical of the 'Veenkoloniale' disease referred to above. The tips of the leaves turn white or pale green and the panicles are more or less 'deaf', resulting in a reduction or failure of yield. Affected plants develop numerous lateral culms. A distinct stunting, especially of the stem culm, is apparent. The only remedy so far discovered for the control of the disease, which is due to the accumulation of a black, amorphous, peaty substance in undrained, water-logged places in the fields, is the application of urban, and particularly sewage, refuse.

Turconi (M.). **Note di patologia vegetale. 1. Un' infezione di Botrytis cinerea Pers. in giovani frutti di Vaniglia (Vanilla planifolia Andr.).** [Notes on Plant Pathology. 1. An infection by *Botrytis cinerea* Pers. of young Vanilla fruits (*Vanilla planifolia* Andr.)]—*Riv. Patol. Veg.*, xiii, 9–10, pp. 157–161, 1923.

Botrytis cinerea Pers. is recorded as an active parasite on a new host, *Vanilla planifolia*, at Pavia, in Italy. The plants which are artificially pollinated generally flower once a year, but in 1923 two distinct flowerings occurred, one in March, and the other in July to August. About ten days after the first flowering a brownish discoloration appeared at the tips of some of the young fruits and progressed downwards, and eventually the characteristic fructifications of *B. cinerea* covered the whole surface. It is thought that the excessively damp conditions prevailing enabled the *Botrytis*, after growing on the wilting flowers, to become vigorous enough to invade the living tissue of the young pods. The second lot of fruits grown in August under dry weather conditions showed no trace of infection.

Sauri (F.). **El mosaico de la Caña de Azúcar.** [Mosaic of Sugar-cane.]—*Rev. de Agric. Republica Dominicana*, xviii, 6, pp. 101–104, 1923.

The mosaic disease of sugar-cane is briefly discussed and suggestions are made for replacing the varieties now grown in the Dominican Republic (where the industry is not nearly as important as in Cuba) with immune varieties such as Uba.

Roguing out the diseased canes could, the author thinks, be much cheapened by burning them *in situ* by means of a portable blow-lamp such as is used in California for eradicating lucerne dodder.

B[arber], (C. A.). **Root disease of the Cane in Barbados.**—*Intern. Sugar Journ.*, xxv, 298, pp. 514–518, 1923.

The principal recent literature on root disease of sugar-cane in Porto Rico, Hawaii, and Java is reviewed, and a useful *résumé* of the present state of information on the subject given.

Westerdijk (Johanna). **Centraalbureau voor Schimmelcultures.** [The Central Bureau for Fungous Cultures.]—*Rept. Intern. Conf. Phytopath. & Econ. Entom., Holland, 1923*, pp. 165–169, 1923.

The author describes the difficulties, mostly of a financial nature, with which the Central Bureau for Fungous Cultures has had, and still has, to contend since its inception in 1904. At the present time the collection comprises about 1,200 type cultures, all of which are not officially listed, as a certain number of cultures are still uncertain or contaminated. Some hints are given on the best methods for cultivating the fungi, both saprophytes and parasites, on artificial media; thus, for instance, cherry-decoction with agar is said to be a much more suitable medium for parasites than the prune-juice agar generally used. The necessity is also stressed of frequently transferring the fungi to a new substrata in order to prevent their degeneration. In terminating the author appeals to

the co-operation of other countries in sending to the Bureau species not yet represented in their lists.

Gaignebet (J.). **La culture de la Truffe dans le Causse de Martel.** [The cultivation of the Truffle in the Causse de Martel.]—*Rev. Bot. appliquée*, iii, 26, pp. 660–666, 1923.

An account is given of the history and methods of the cultivation of truffles (*Tuber melanosporum*) in the Causse de Martel, Dordogne [south-west of France]. The fungus, which is in great demand as a culinary delicacy, grows chiefly in mycorrhizal symbiosis with the oak, though it has also been found beneath juniper, walnut, and chestnut trees. It requires a calcareous soil and a permeable sub-soil, which need not, however, be deep, as the truffles are not found more than 15 cm. from the surface. The present production of truffles in the Martel district from November to March has been estimated at 41,500 kg., the price per kg. since the war ranging from 15 to 60 francs.

Eriksson (J.). **Zur Kenntnis der schwedischen Phragmidium-formen.** [Contribution to the study of the Swedish *Phragmidium* forms.]—*Arkiv. f. Botanik*, xviii, 4, pp. 1–34, 1 pl., 6 figs., 1924.

The author describes a number of observations and experiments made on four species of *Phragmidium* mostly in the early years of the present century. He considers that clear evidence was obtained that *P. subcorticium* persisted for three years in a bed of *Rosa rubrifolia* by means of overwintering mycelium, only the aecidial stage appearing during this time. Experiments with the teleutospores of this species indicate that infection from them only occurs when the spores have been exposed to the rigours of winter. No successful inoculations were obtained with this species when aecidiospores formed from overwintered mycelium were used, even though the spores possessed high germinative capacity, and the author suggests that such aecidia may possess a different biological constitution from those formed from infections in the current year.

With *P. rubi-idaei*, on the raspberry, inoculation experiments with the teleutospores gave copious infections; those with aecidiospores and uredospores failed. *P. violaceum* on *Rubus laciniatus* and *R. fruticosus* gave very weak infections, and the author was not able to decide how the parasite continued from year to year.

Foëx (E.). **Quelques faits relatifs aux Erysiphacées.** [Some facts relating to the Erysiphaceae.]—*Rept. Intern. Conf. Phytopath. & Econ. Entom., Holland, 1923*, pp. 184–190, 1923.

The greater portion of the work on the Erysiphaceae described in the present paper was carried out at Montpellier, France, from 1903 to 1912. Although the study is admittedly incomplete, the observed facts lead the author to the conclusion that there are four main types of conidiophores: (1) in which the basal cell performs the functions both of a pedicel and of the generative cell of the conidial mother-cells; (2) in which a unicellular pedicel bears a mother-cell on which a chain of cells, destined to form conidia, is

developed; (3) in which a very elongated conidiophore, attenuated at the base, bears only a single conidium, the mother-cell being situated immediately above the pedicel; and (4) in which the pedicel is usually multicellular and may bud off several conidiophores; the primary conidial organ is not borne above an external mycelium and perpendicularly to the latter, but at or near the extremity of an endophytic hyphae of which it appears to be an extension.

There are three factors which determine the number of conidia in the chain: (1) the degree of activity of the generative cell (the mother-cell); (2) the rapidity of differentiation; (3) the rapidity of disarticulation. The number is not constant for a given species, though under normal environmental conditions it is fairly stable.

The formation of perithecia is very variable. Some species produce them in great numbers on all their hosts, while others form them only on some of their hosts. The author thinks with Neger that a rich medium, such as is furnished by fresh and turgescent plant organs, favours the formation of conidia, while temperature and humidity appear to be of secondary importance. The formation of perithecia, on the other hand, depends on the supply of nutrition from the old organs, especially if these are not exhausted through the production of numerous conidia. The latter are generally formed on the young leaves or stalks, while perithecia often appear on the older plant portions.

Several of the Erysiphaceae do not develop well under very damp conditions; a certain degree of humidity favours them, but they are able to adapt themselves to conditions of moderate drought.

Specific examples illustrating these various points are given.

WESTERDIJK (JOHANNA). **Untersuchungen über Nectria coccinea Pers. und Nectria galligena Bresadola.** [Investigations on *Nectria coccinea* Pers. and *Nectria galligena* Bresadola.]—*Rept. Intern. Conf. Phytopath. & Econ. Entom., Holland, 1923*, pp. 171–173, 1923.

The results of extensive culture experiments with *Nectria coccinea* and *N. galligena* revealed certain constant differences in the ascospore dimensions of the two species. The average length of the ascospores of the fungus found on the Pomaceae was 17 to 18 μ and corresponded to the measurements given for *N. galligena*. On other deciduous trees (lime, poplar, beech) a smaller form, with ascospores of 12 to 13 μ in length and agreeing with *N. coccinea*, was usually found. In both cases the fungi were isolated indiscriminately from cankers and from smooth, dead areas of the cortex, thus casting doubt on Weese's theory that *N. galligena* is the canker-producing organism and *N. coccinea* confined to smooth portions of the bark.

N. coccinea and *N. galligena* are not easily distinguishable in culture by macroscopic characters, but considerable differences exist between the various strains of each species, especially as regards colour. As a rule the *coccinea* cultures develop a more copious aerial mycelium and less spore mucilage than those of *galligena*. Little difference was observed between the species in

respect of their reaction to the hydrogen-ion concentration of the medium. The spores of *N. coccinea* were generally somewhat more curved than those of *N. galligena.*

N. coccinea was isolated from canker of poplar and beech, as well as from the cortex of beech and elm. *N. galligena* was occasionally observed on beech and willow cankers, but not so frequently as on those of Pomaceae. It is even capable of causing the decay of apple fruit. The author concludes, therefore, that *N. galligena* occurs primarily on the Pomaceae and *N. coccinea* on the other hardwoods.

Inoculation experiments resulted in the production of cankers on poplar branches by *N. coccinea,* to which the occurrence of these cankers in nature must therefore be ascribed. Isolated from beech cortex and from poplar cankers, *N. coccinea* produced typical cankers on the Bismarck variety of apple. Both species caused canker formation on beech.

Nectria ditissima, the re-establishment of which was proposed by Wollenweber on morphological grounds, would almost certainly be found to fall into one of the two species under discussion if the biometric method of ascospore measurement were used.

TUNSTALL (A. C.). **Some observations on micro-organisms associated with Tea fermentation.**—*Quart. Journ. Indian Tea Assoc., 1923,* iv, pp. 126–131, 1924.

An investigation was made of the micro-organisms found in fermenting tea leaves. The various organisms, chiefly bacteria and yeasts, were first isolated and grown in pure culture. Sterilization of the leaves could not be effected, either by heat or by chemical substances, without altering their composition and nature. It was therefore decided to conduct the inoculation tests with such overwhelming numbers of the organisms involved that the effect of those already present would be masked. The results of the preliminary experiments showed that the bacteria caused undesirable taints, while the yeasts produced an agreeable aroma which varied with the species.

Aspergillus niger was found to secrete an enzyme when grown on tea-tannin. This was isolated and its action tested on tea leaves in which the natural enzymes had been disorganized by heat. The changes induced by the mould enzyme apparently resemble those due to withering; rawness was converted into pungency and the green colour of the infusion became a golden yellow. The brown colour characteristic of fermentation was not apparent even after 21 hours. Experiments with the enzymes produced in the leaves during withering and by various yeasts indicated that the latter were responsible for the aroma of fermenting tea. No aroma was observed unless the leaf had first been withered or exposed to the action of the tea or mould enzymes.

Experiments were also carried out to ascertain the identity of the micro-organisms naturally present on tea leaves at all stages from growth to manufacture. Yeasts were found to predominate, a steady increase in the number of yeast cells being observed during the manufacturing process, which reached a maximum at the completion of fermentation. The rollers, sifters, fermenting floors, &c., con-

tained few yeasts, but many bacteria, some of which imparted characteristic taints to the tea.

Samples of tea juice expressed during rolling were obtained from numerous gardens, and pure cultures prepared of the yeasts present therein. The effects of these were then tested by inoculating the leaf at various factories. Yeast-treated tea was found to be less brisk than the untreated controls and often fermented more rapidly, with a correspondingly speedy rise of temperature. By a more sparse distribution of the leaf on the fermenting floors the temperature of the yeasted tea could be kept down and when this was done the duration of fermentation was approximately equal in treated and untreated tea. When the leaf was pressed down to exclude the air there was no rise of temperature and the time of fermentation was considerably protracted. Further experiments indicated that the yeasts have no direct action on tannin.

By using yeast from a particular factory it was found possible to reproduce the characteristic aroma of the leaf in that factory under widely divergent conditions.

Observations of the micro-organisms present on the leaf at different times of the year showed that the quantity of yeast on the fresh leaf is at its maximum when the best quality teas are being manufactured. Yeasts isolated and cultured at this time were inoculated into the leaf when the quality had deteriorated with very beneficial results.

The addition of yeast cultures, while markedly improving the aroma and flavour of naturally insipid teas, cannot impart to the latter the superior qualities of the Darjeeling or Upper Assam varieties. Pungency, strength, and appearance are not affected, and the amount of flavour produced does not approach that of high-class teas. Nevertheless, they would seem to be valuable agents in tea manufacture, requiring further study.

GÜSSOW (H. T.). **International plant disease legislation as viewed by a scientific officer of an importing country.**—*Rept. Intern. Conf. Phytopath. & Econ. Entom., Holland, 1923*, pp. 96–107, 1923.

After expressing himself wholly in favour of international co-operation and community of action against the spread of insect pests and plant diseases, the author stresses the difficulties lying in the way of such co-operation between America and Europe in view of the disparity of the interests of both continents. Up to recent times America was essentially an importer of nursery stock from Europe, and owing to the laxity of its import regulations a number of severe diseases have been introduced, such as the blister rust of white pine [*Cronartium ribicola*]. This led her to protect her natural resources by ever stricter quarantine laws on imported stocks, such measures calling for severe criticism from the exporters in Europe, who accuse her of being more concerned in raising a wall of protection in favour of her home producers than in taking preventive measures on strictly biological grounds, and also from American importers, for whom it meant a loss of trade and not a question of guarding the country against destructive diseases or

pests. In the author's opinion, however, America has no other alternative, as he is not clear what internationally acceptable arrangement could possibly cover not only all the essential points but also the special requirements of each nation. As far as Canada's present regulations are concerned, they have been devised with a view to attempting to protect herself from the invasion of foreign pests and diseases as far as possible under the present circumstances of international trade.

This paper gave rise to an animated discussion, which is briefly summarized on pp. 113–116.

Saatenanerkennung und Pflanzenschutz im Jahre 1922. [Seed certification and plant protection in 1922.]—*Nachrichtenbl. deutsch. Pflanzenschutzdienst*, iii, 11, p. 81, 1923.

The following statistics, collected by the Biological Institute [Dahlem] in co-operation with various other bodies, show that a considerable proportion of the cereal and potato crops inspected during 1922 failed to pass the certification standard on account of fungous diseases.

Certification was refused on account of bunt [*Tilletia tritici* and *T. levis*] and loose smut [*Ustilago tritici*] of wheat in 2,681 and 1,291 hect. respectively out of 45,382 hect. inspected; stripe disease of barley [*Helminthosporium gramineum*] in 506 hect. out of 28,471 hect. inspected; loose and covered smut of barley together [*U. nuda* and *U. hordei*] in 1,910 hect. out of 28,471 hect.; loose smut of oats [*U. avenae*] in 2,740 hect. out of 39,108 hect. inspected; and potatoes (all diseases) in 6,571 hect. out of 61,876 inspected.

PETCH (T.). **Importation of Tea seed from India.**—*Trop. Agric.*, lxi, 5, pp. 259–265, 1923. [Received 1924.]

The history, origin, and distribution of blister blight of tea are described, with special reference to the viability of the spores of the causal fungus (*Exobasidium vexans*).

The necessity of prohibiting the importation of tea seed from India is insisted upon for the following reasons. The transference of blister blight, presumably with the seed, over long distances is an established fact. The failure of spores of *E. vexans* to germinate after a few hours or days in laboratory tests does not necessarily correspond with the development of the fungus in nature. It has been proved [see this *Review*, i, p. 329] that disinfection cannot kill the spores within the seed. Under present conditions in Ceylon the author regards importation of tea seed as an unjustifiable risk.

IMPERIAL BUREAU OF MYCOLOGY

REVIEW

OF

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Grove (W. B.). **The British species of Ceuthospora and Cytosporina.**—*Kew Bull. Misc. Inform., 1923,* 10, pp. 353–359, 1923.

This is a continuation of the author's work on *Cytospora* [see this *Review*, ii, p. 391]. *Cytosporina* differs from *Cytospora* mainly in the great length and rather different shape of its spores, and also in the fact that usually the perfect form must be sought in the genera *Eutypa* and *Cryptosphaeria*. *Ceuthospora* is a more difficult genus, and the author proposes as a generic character the possession of pycnidia of two kinds (*a*) a smaller one resembling a unilocular *Cytospora*, and (*b*) a more sclerotioid form which, however, always produces conidia of the same type as in (*a*).

On *Prunus laurocerasus* the author recognizes four species belonging to these genera: *Ceuthospora laurocerasi* Grove on the leaves and small twigs, recognized by its two types of pycnidia; *Cytospora laurocerasi* Fckl p.p., with a colourless spore mass and belonging to *Valsa laurocerasi* Tul; *Cytospora leucostoma* Sacc., with a distinctly pinkish spore mass and belonging to *V. leucostoma* Fr.; and *Cytospora ambiens* Sacc., with spore mass white and tendrils white, soon becoming pale amber or turbid yellow, and belonging to *V. ambiens* Fr.

Cytosporina ribis Magn. on *Ribes grossularia* is listed as a doubtful species. None of the specimens seen answers to the description, and the figure of the spores by Brooks and Bartlett suggests the b-spores of a *Phomopsis*.

T[unstall] (A. C.). **Root disease in North Lakhimpur.**—*Quart. Journ. Indian Tea Assoc., 1923,* iv, pp. 132–133, 1924.

Brown root disease of tea (*Fomes* [*lamaoensis*]) is stated to occur in an extremely severe form on the sandy soils of North Lakhimpur district. Directions, based on thorough sanitation and the eradication of all infected material, are given for the control of the disease, which has been known to cause very heavy losses,

especially in young plantations in sandy soils from which the virgin forest has recently been cleared.

D'ANGREMOND (A.). **Jaarverslag van het Proefstation voor Vorstenlandsche Tabak 1 Mei 1922—30 April 1923.** [Annual Report of the Experiment Station for Vorstenland Tobacco, 1st May 1922 to 30th April 1923.]—*Proefstat. Vorstenlandsche Tabak, Meded.* xlix, pp. 31–50, 1923.

The following references of phytopathological interest are included in this report.

The results of a series of experiments in the application to soil infested by *Phytophthora nicotianae* of 'dessa' manure mixed with carbon disulphide showed that the latter almost completely counteracts the well-known tendency of the former [see this *Review*, ii, p. 36] to increase the incidence of the disease. Heavy infection was observed on the plots treated with 'dessa' manure alone. Very good results were also obtained by the application of sulphate of ammonia combined with double superphosphate, which appears to form a valuable substitute for organic manure. A further substitute for 'dessa' earth which shows promise is fermented rice straw.

There were no severe outbreaks of slime disease [*Bacterium solanacearum*] during the period under review.

D'ANGREMOND (A.). **De veldschimmel (Oïdium spec.) in de Vorstenlanden.** [The field fungus (*Oidium* sp.) in the Vorstenland.]—*Proefstat. Vorstenlandsche Tabak, Meded.* xlix, pp. 7–25, 1 pl., 1924. [English summary.]

Tobacco mildew [see this *Review*, i, p. 275] continues to cause very severe damage in the Vorstenland district of Java, where investigations on its control are in progress.

The cause is a species of *Oidium*, which may be identical with *Erysiphe lamprocarpa* [*E. cichoracearum*] occurring in Portugal and Italy, but has not yet definitely been identified owing to the failure to discover the perithecial stage. The principal damage occurs in fields with a high water-level and in the 'dessas' (native villages) where sun and wind are unable to penetrate freely. The disease generally reaches its climax during October, when the humid conditions favour the development of the fungus. Heavy rain, however, is very beneficial in checking its progress.

Contrary to the prevalent opinion that the first symptoms of the disease appear on the upper surface of the leaf, the author has always found them on the under side. Later centres of infection are formed on the upper side, from which the fungus spreads in all directions, chiefly following the lateral veins.

The total amount of mildew in the 1921 harvest was estimated at 3 and in 1922 at 4 per cent. of the leaves. These comparatively low figures do not, however, give a correct idea of the damage, since the best leaves, namely, those at the base and middle of the plant, are more heavily attacked (13 to 18 per cent.) than those at the top. Infected material is absolutely unsaleable in America (the principal market), with the result that considerable financial losses are sustained.

A series of experiments in the control of the disease was undertaken in 1918, two plots, (*a*) and (*b*), being sprayed with Bordeaux mixture and lime-sulphur respectively, and a third (*c*) dusted with sulphur, while a fourth was left untreated. Neither (*a*) nor (*b*) gave adequate control of the disease, the percentage of healthy plants in the plots so treated being only 8·06 and 48·77 respectively; in (*b*) there was also considerable burning. In the control plot only 1·76 per cent. of the plants were healthy. Almost absolute control was secured by dusting with sulphur (98 to 99 per cent. healthy after drying), but the fact that a deposit of sulphur particles remains on the leaves, even after drying, fermentation, and sorting, unfortunately disqualifies this treatment from further use.

Attempts were subsequently made to reduce the incidence of the disease by such measures as the clearance of young tobacco plants from the drying-barns, and the eradication from the fields of the weed *Heliotropium indicum*, which is highly susceptible to mildew, but without much success. No correlation could be traced between the application of 'dessa' manure and the incidence of infection.

In 1922, after a study of the control measures adopted against *Oidium* of the vine in Switzerland, the author instituted a series of tests in the prevention of tobacco mildew by powdering the soil between the plant rows with about 500 kg. of sulphur per hect. The plants in the treated plots remained perfectly healthy, while those in the control plots, which alternated with those that had received sulphur, also showed scarcely a trace of infection. The effect of the sulphur was even felt in two plots on the north of the experimental field, to which the powder was carried by the prevailing southerly winds. After drying and fermentation, the total quantity of healthy tobacco from the treated plots was 98 per cent., from the untreated alternating plots 90 per cent., and from those outside the experimental plots 41·63 per cent.

It is hoped that, owing to the great expense of the treatment, smaller quantities of sulphur may be found effective.

Gandrup (J.). **Onderzoekingen over het optreden van dufheid in tabak.** [Investigations on the occurrence of mustiness in Tobacco.]—*Meded. Besoekisch Proefstat.* 35, 23 pp., 1923. [English summary.]

Prepared and cured Java tobacco sometimes becomes musty, and even when shipped to Europe apparently in good condition it has sometimes a musty odour on arrival.

Investigations carried out in Java to ascertain the cause of this defect showed that it was not associated with any of the fungi [a list of which is given] commonly isolated from the leaves, and the same was true of the numberless species of bacteria occurring on the leaves. Positive results, however, were obtained in experiments [particulars of which are given] with several undetermined species of *Actinomyces*, artificial inoculation with which produced the same odour as that occurring on naturally infected leaves.

It is thought that the leaves become infected in the field from the soil, in which the Actinomycetes are practically ubiquitous and

which is splashed on to them by heavy rain. Such contaminated leaves must be kept in a dry state and stored in a well-ventilated room. A temperature of about 60° C. should be maintained during the curing process, in order to kill any Actinomycetes present.

Excessive moisture in the leaves and storage in cool, badly ventilated rooms almost always leads to mustiness. This is why the native cured or 'krossok' tobacco is particularly liable to the trouble.

It was definitely ascertained that mustiness is infectious, spreading easily from diseased to healthy leaves.

During the investigations it was found that the white efflorescence on the leaves, often known as 'saltpetre' or 'beschlag' and occurring also on musty coffee seed, consisted of *Actinomyces* spores.

PALM (B. T.) & JOCHEMS (S. C. J.). **Andreaea deliensis n. gen., n. sp., de groote stapelschimmel van de Deli-Tabak.** [*Andreaea deliensis* n. gen., n. sp., the large stack fungus of Deli Tobacco.]—*Deli Proefstat. Medan-Sumatra Bull.* 19, 20 pp., 3 pl., 1 fig., 1923. [English summary.]

In 1921 and 1922 a fungous decay was observed to be causing serious damage to stacks of fermenting tobacco on the east coast of Sumatra. All parts of the plant except the sand leaves were attacked. On the removal of the top layers (1 to 2 ft.) from affected stacks, the fungus was found covering the entire surface, except for a margin of about 2 ft. In severe cases the veins and other portions of the leaves appear as though covered with lime. The spots, consisting of white, flocculent mycelia, are 1 to 10 mm. in diameter; they are easily removed by hand and cause little or no actual damage even when the leaf tissues are penetrated.

A similar disease known as 'fioritura', caused by *Oospora nicotianae*, has been recorded from Italy (*Riv. tecn. e di Ammin.*, 1899), while in other parts of Europe an undetermined species of *Oospora* is stated to be responsible for damage to harvested tobacco.

The Sumatra fungus, which was isolated from diseased material and cultured on various nutrient media, is regarded as belonging to a new genus of the Aspergillaceae, and is named *Andreaea deliensis* n. g., n. sp. [see following abstract]. It is characterized by a profusely branched, irregularly septate mycelium, the conidia being borne in chains on short lateral branches, not differentiated into definite conidiophores. The conidia are hyaline, oblong, and about 3 μ in length. In culture white, later dark brown, sclerotia, very similar to those of *Penicillium italicum*, are formed in large numbers. When fully grown they measure about 0·4 mm., but they have hitherto remained sterile.

Inoculations on cured tobacco leaves of the Deli, Havana, and Seedleaf varieties at a temperature of about 28° C. resulted in an abundant mycelial and conidial development. Very luxuriant growth of the fungus in all stages was secured on potato plugs, commercial agar, and bouillon peptone agar at 28° C., and on the

last-named medium at 39° also. Fair growth occurred on concentrations of saccharose varying between 5 and 60 per cent.

The temperature relations of the fungus were found to be as follows: minimum 18° to 20°, optimum 32°, maximum (for growth) 40° to 41° C. The thermal death point was 48°, provided a sufficiently lengthy exposure was given.

In view of the fact, which was established, that the fungus is capable of developing only on practically saturated leaves, control measures should be based on a reduction of excessive moisture. All curing and packing operations must be carried out under dry conditions; infected stacks should be pulled down and the plants thoroughly aired and rearranged. Special attention should be paid to tobacco for export. If this arrives in Europe in a sound condition the low temperature prevailing there should prevent any fresh development of the fungus.

Rectificatie van Bulletin No. 19 van het Deli Proefstation te Medan-Sumatra. [Rectification of Bull. No. 19 of the Deli Experiment Station, Medan, Sumatra.]—1924.

Attention is called to the fact that the name *Andreaea* [see preceding abstract] had already, unknown to the authors, been applied to a genus of mosses, and the new name *Andreaeana deliensis* is therefore proposed for the stack fungus of tobacco.

EYLES (F.). **Bacterial infection of Tobacco seed beds.**—*Rhodesia Agric. Journ.*, xx, 6, pp. 693–694, 1923.

Serious damage to some of the Rhodesian tobacco crops from bacterial leaf spot was reported in 1923, when the plants had reached the 'topping' stage.

No seed-bed infection was observed by the planters, but the writer found small areas in seed-beds near Salisbury in which the plants had damped off, and bacteria were found in the collapsed tissues and in a few leaf spots that occurred on affected plants. Their identity was not established, but they are thought to be either the blackfire or wildfire organisms [*Bacterium angulatum* or *Bact. tabacum* respectively].

Seed-bed areas showing symptoms of damping-off should be sprayed with a 1 in 15 solution of formalin or destroyed by burning, and weekly sprayings with Bordeaux mixture (4–4–50) should be given to the seed-beds.

BATCHELOR (L. D.). **Methods of harvesting and irrigation in relation to moldy Walnuts.**—*California Agric. Exper. Stat. Bull.* 367, pp. 677–696, 1 col. pl., 1923. [Received 1924.]

During the last few years Californian walnut-growers have experienced very heavy losses owing to the presence of mouldy kernels associated with *Alternaria*, *Penicillium*, *Cladosporium*, *Fusarium*, *Macrosporium*, *Mucor*, and *Sclerotinia*, principally the first-named.

The mould, which is most prevalent on sandy soil and in seedling groves, may make its appearance any time after the husks begin to crack, the fungus starting growth on the damp lining of the husk and spreading to the kernels. The first drying out at the beginning

of the curing process checks any further development, but if harvesting operations are delayed the infection spreads rapidly, especially among the nuts which drop to the ground with husks adhering to them.

Plentiful irrigation is stated to be the best preventive of mouldy walnuts. In one experiment each 100 lb. of nuts from the crop of a dry plot was worth at least $7·50 less than the corresponding quantity from a continuously irrigated plot. With an average crop of nuts (825 lb. per acre) this would represent a loss of $61·88 per acre.

SPIERENBURG (DINA). **New Elm tree disease.**—*Rept. Intern. Conf. Phytopath. & Econ. Entom., Holland, 1923,* pp. 123–124, 1923.

With reference to the disease which has been recently discovered in Holland severely attacking elm trees [see this *Review*, ii. pp. 1, 92], the author states that numerous artificial infection experiments made with *Graphium ulmi* on healthy elms have so far given negative results: a discoloration of the xylem was indeed obtained, but none of the trees infected showed any symptoms of wilting or browning of leaves. The author believes that climatic conditions, especially drought, have a great influence on the outbreak and the course of this disease.

VANINE (E.). **La pourriture annulaire du Chêne, produite par le Vuilleminia comedens Maire.** [Ring rot of Oak, caused by *Vuilleminia comedens* Maire.]—*Rept. Intern. Conf. Phytopath. & Econ. Entom., Holland, 1923,* pp. 263–264, 2 figs., 1923.

In 1918, while investigating the parasites of forest trees in the Romanovsk forestry district of the government of Tamboff [Russia], the author observed in pure oak stands that some 3 per cent. of the young oaks from 10 to 20 years old and about 5 cm. in diameter were dying from the attacks of *Vuilleminia comedens.*

Most of the trees were still alive, but their lateral branches were dead, and in many cases their tops showed obvious symptoms of wilting. On each tree the fructifications of the fungus were easily visible as ochre-yellow or yellowish-grey, sub-cortical crusts, about 35 cm. in length and extending over half or three-quarters of the circumference of the trunk. The rot caused by the fungus appears in transverse section as a whitish ring from 0·5 to 1 cm. in thickness on the periphery of the trunk; in consistency it is softer than the healthy wood circumscribed by it. In the ring, and particularly in its peripheral portion, the mycelium, consisting of hyphae from 2 to 2·5 μ in diameter, is easily distinguishable, even with the naked eye, as a white felting occupying the position of the spring wood. On the more slender limbs the parasite did not usually form rings but invaded the whole thickness of the branch. Microscopic examination showed that the organism first invades the bast and thence penetrates the wood, slightly corroding the walls of the vessels.

General conditions in the locality were favourable for the development of the fungus. The oaks were growing on high, dry ground and this tells against Lind's suggestion that *V. comedens* can become a parasite only on trees growing on damp soil.

Vanine (E.). **Le Hydnum septentrionale, parasite des arbres à feuilles.** [*Hydnum septentrionale*, a parasite of broad-leaved trees.]—*Rept. Intern. Conf. Phytopath. & Econ. Entom., Holland, 1923*, pp. 264–267, 1 pl., 2 figs., 1923.

In the autumn of 1922 a large number of maples (*Acer platanoides*) and elms (*Ulmus effusa*) in the Forestry Institute of Petrograd and in the neighbourhood were found to be attacked by *Hydnum septentrionale*. In the case of a maple 90 years old, 22 m. in height, and 30 cm. in diameter, the hymenophore of the fungus was placed at a distance of about 1·50 m. from the soil; it measured 25 cm. in height by 17 cm. in breadth and consisted of a large number of thin layers superimposed in tiers; the upper surface of each layer was white and hirsute when fresh, but turned yellow on drying. The teeth were white, slender, and 1 cm. in length; spores ellipsoid, 8 by 3·7 μ; and cystidia long, conical, and sparse. The basidia, after abstriction of the basidiospores, continue to grow vegetatively, and after a short time the teeth are covered with diverging tufts of basidia which give them a peculiar aspect.

The tree was felled for examination and it was found that the rot, which had destroyed about 30 per cent. of the total bulk of the wood, extended upwards in the trunk to a height of 6·30 m. and downwards to the base. The decay was spreading from the centre, only leaving a ring of healthy wood at the periphery, from which it was separated by a ring of hardened wood with a brown discoloration. Inside the central portion the decay was not uniform: amid the rotted mass of a whitish-yellow colour there still were islands of healthy wood of a somewhat darker tint. The wood fibres and the parenchymatous cells between the medullary rays were the most disorganized; along the latter were longitudinal fissures which were soon lined with a thin, milky-white mycelial membrane. In the more advanced stages of decay the wood easily disintegrated into thin layers, thus producing concentric fissures following the direction of the annual rings.

Microscopic examination showed that the medullary rays resisted the decay longest. In all the attacked tissues were found branching hyphae, from 1·5 to 3 μ in diameter. The walls of the wood fibres containing the hyphae, when treated with phloroglucine and hydrochloric acid, took on a much weaker stain than those of the fibres free from hyphae, thus showing that disorganization was commencing. The pigment contained in the tissues of the brown ring mentioned above would appear to belong to the group of substances now known under the name 'Kernstoff' (wound-gum or 'Schutzgummi' of older authors), and which, according to Münch, is an oxidization product of the cells killed by the parasite.

Hydnum septentrionale was also found in 1922 attacking lime trees [*Tilia*] in the park of Peterhof near Petrograd.

Richards (B. L.). **Soil temperature as a factor affecting the pathogenity of Corticium vagum on the Pea and the Bean.**—*Journ. Agric. Res.*, xxv, 11, pp. 431–449, 2 pl., 6 figs., 1923.

In his further studies on the pathogenicity of *Corticium vagum* as affected by soil temperature [see this *Review*, i, p. 261, and iii, p. 361], the author determined, in experiments made under con-

trolled conditions in the greenhouse, that the fungus may become a vigorous parasite on the underground parts of the pea and the bean. The temperature relations for the pathogenicity of the organism on these two plants are essentially the same as for potato and cotton; lesions occurred at temperatures between 9° and 29° C., with an optimum for tissue destruction at 18°, with all the different strains of the fungus tested. As the temperature requirements for optimum growth of the bean and cotton are higher than those of the pea and potato, it is suggested that the effect of temperature on the resistance of the host is of minor importance in influencing the severity of the disease, the virulence of the fungus being independent of the temperature relations of the host. Unlike the results obtained with the potato, the injury caused to peas and beans was greatly increased in sterilized soil inoculated with a pure culture of the fungus.

In pure culture the fungus was found to be able to grow at temperatures between 4·6° and 32·6° C. with an optimum for a period of 96 hours between 25° and 27°; the rate of growth of the mycelium on hard agar between 23·6° and 32·6° decreased with the time of exposure, this suggesting a much lower optimum for the continued growth of the fungus. At lower temperatures the hyphae embedded themselves in the substratum and retained their active state much longer than at higher temperatures, at which the mycelial growth was more superficial with a copious production of aerial hyphae. It is thought probable that the closeness of growth to the substratum at the lower temperatures plays an important part in the ability of the fungus to attack living tissues at temperatures below 21° C. It is quite probable, also, that tissue destruction is due to enzymes secreted more abundantly at 18°, or acting more vigorously at this than at other temperatures, though there is no direct evidence on this point.

MIÈGE (E.). **Ennemis et maladies de la Betterave observés au Maroc.** [Pests and diseases of Beetroot in Morocco.]—*Rev. Path. Vég. et Ent. Agric.*, x, 4, pp. 339–341, 1923.

Of the three chief fungi attacking beetroot in Morocco, namely, *Sphaerella tabifica*, *Uromyces betae*, and *Cercospora beticola*, the first is the most serious. It generally appears during periods of drought, and towards the end of the season; roots remaining in the field in July, August, and September, under conditions of absolute dryness and high temperature, are most subject to attack. At Rabat the author also found two plants with very numerous and bulky nodosities caused by a fungus which Foëx has identified as a species of *Sclerotium*.

WEIMER (J. L.). **Two diseases of Udo (Aralia cordata Thunb.)**—*Journ. Agric. Res.*, xxvi, 6, pp. 271–278, 4 pl., 1923.

The causes of two diseases of udo (*Aralia cordata*), a plant introduced into the United States in 1903 from Japan, where it is grown extensively for food, have been investigated by the author.

A root rot accompanied by a brown discoloration of the leaves and base of the stem, the affected portions being generally covered with large, black, irregular sclerotia, was found to be due to a

fungus closely resembling, and probably identical with, *Sclerotinia libertiana*. Attempts to secure the development of apothecia from the sclerotia, however, have proved unsuccessful. The fungus was isolated in pure culture and inoculations gave positive results on wounded plants. Softening of the tissues, due to the solution of the middle lamellae of the cell walls, and browning of the vascular bundles took place considerably in advance of penetration by the hyphae.

S. libertiana from an authentic strain inoculated into udo produced a disease with similar symptoms to those caused by the udo fungus.

A wilt disease, causing a very gradual decay of the plants from the top downwards, was found to be due to *Verticillium albo-atrum*, which was isolated from infected plants and produced the typical symptoms of wilt in inoculated udo and eggplants. This is believed to be the first record of the fungus on udo.

No control measures other than the usual sanitary precautions can be suggested for these diseases. There are some indications that the wilt is less destructive on heavy soil than on light, sandy loam.

PUTTERILL (V. A.). **Plant diseases in the Western Cape Province. X.**—*Journ. Dept. of Agric. S. Africa*, vii, 4, pp. 332–336, 4 figs., 1923.

Amongst the fungi found attacking grapes packed for export the following appear to be the most frequent in South Africa: *Botrytis cinerea*, *Penicillium* spp., especially *P. expansum*, *Rhizopus* spp., particularly *R. nigricans*, and *Aspergillus niger*. During the 1923 season the first two were apparently the most common in wasty consignments. *Botrytis cinerea* (*Sclerotinia fuckeliana*), very virulent in Europe, is of importance in the field only in certain localities in South Africa. The mould is difficult to keep in check, as the spores are very resistant. The following treatment has given good results: washing the vines, in the dormant season, with a 5 per cent. solution of calcium bisulphite, followed in the growing season by powdering the grapes with a mixture of 10 parts of bisulphite and 90 parts of powdered clay. Applications of sulphate of iron in the winter and spraying with sulphide of potassium solution in the spring and summer are also stated to be efficacious.

Survey of the prevalence of plant diseases in the Dominion of Canada. 1923.—*Fourth Ann. Rept. Canada Dept. of Agric., Exper. Farms Branch*, 125 pp., 1924. [Mimeographed.]

This Report, prepared on the lines of previous compilations of the same nature [see this *Review*, ii, p. 303] and edited by the Plant Pathologist, F. L. Drayton, contains a variety of interesting information on the incidence, distribution, and effects of important fungous and physiological diseases of plants.

Stem rust of wheat (*Puccinia graminis*) extended over a much wider area in Alberta than was recorded in any other year, but appeared too late to do serious damage. Very considerable losses,

however, occurred in Saskatchewan. At Indian Head the Kubanka variety was severely affected. In Manitoba the pycnidia of the fungus were first noticed on barberries on 31st May at Winnipeg, the aecidia on the same host opening on 5th June. Throughout the province the disease was very serious, resulting in a loss of about 50 per cent. (35,000,000 bushels or $15,000,000 to $35,000,000) of the harvested wheat. These losses exceed any resulting from stem rust since 1916.

Amongst the other records of wheat diseases may be noticed take-all (*Ophiobolus cariceti*), which occurred in a severe form in one field in northern Saskatchewan; glume blotch (*Septoria nodorum*), which was very prevalent and more severe than usual; and basal glume rot (*Bacterium atrofaciens*), which severely affected wheat throughout Alberta and northern Saskatchewan.

Oat leaves were commonly attacked by halo blight (*Bact. coronafaciens*) in northern Saskatchewan and Alberta.

For ten years past one field at the Central Experimental Farm, Ottawa, has failed to yield healthy oat plants, and the diseased conditions reappeared in the early summer of 1923. The leaves of plants 4 to 5 in. high developed pale patches with brown or reddish edges, finally drooping and withering. Large dead areas occurred in the field and rapidly became filled with weeds, especially *Polygonum pennsylvanicum*. Apparently this is the same disease as one described in Europe under the name of 'grey speck' or 'yellow tip' [see this *Review*, iii, p. 24]. A similar disease is reported from Macdonald College (Quebec), where it causes losses which may range from 20 to 80 per cent.

Stem break of flax (*Polyspora lini*) was severe in two plots at the Saskatoon Agricultural College.

Cane disease of raspberries was prevalent in the Niagara district, causing up to 10 per cent. of infection and occurring in three-quarters of the total number of plantations. It is not yet certain what proportion of the damage is due to cane blight (*Leptosphaeria coniothyrium*) and how much to blue stem (*Acrostalagmus caulophagus*) [considered by Carpenter to be a *Verticillium*, probably *V. albo-atrum*]. It is important to note that blue stem, formerly recorded only on black raspberries, has now been found on the red varieties.

Beans in two districts of Alberta were severely affected (up to 10 per cent.) by *Rhizoctonia* disease (*Corticium vagum*).

Root rot and blight of peas, caused by *Fusarium* and *Pythium* spp., were again reported from Ontario, but in a less severe form than the previous year.

The following data on the incidence of the more important potato diseases were obtained by the inspection of 9,681 acres in 2,914 fields (situated in all provinces except British Columbia), of which 7,099¼ acres in 2,061 fields were passed for certification. The average amount of blackleg (*Bacillus solanisaprus*) [*B. atrosepticus*] in all the fields inspected was 0·62 per cent., and that in those passed 0·36 per cent. The corresponding figures for leaf roll were 0·81 and 0·42 per cent.; for mosaic 2·25 and 0·62 per cent.; and for wilts 0·14 and 0·064 per cent.

Wildfire of tobacco (*Bacterium tabacum*) has not yet been found

in Canada, and angular leaf spot (*Bact. angulatum*), which occurred with great severity in 1922, did not reappear in 1923.

Twenty-five birch trees (*Betula alba* var. *papyrifera* and *B. lutea*) on a representative area in eastern Quebec were felled and examined for the presence of wood rots. All the trees (which were overmature from a silvicultural standpoint) were badly decayed—71 per cent. by *Fomes fomentarius*, 8 per cent. by *F. igniarius*, and 21 per cent. by both fungi.

Chestnut blight (*Endothia parasitica*), which has practically destroyed the chestnut (*Castanea dentata*) forests in the United States, has appeared in two counties of Ontario, where serious losses may be anticipated.

Severe cases of wilt of maple (*Acer negundo*), caused by a species of *Verticillium*, were observed at Ottawa and in one locality of Ontario. The disease produces rapid decay ; in one instance a tree 25 ft. high was killed within three months from the first appearance of the symptoms.

Blister rust (*Cronartium ribicola*) of the western white pine (*Pinus monticola*) now occurs very generally throughout the coastal areas of British Columbia, both wild and cultivated *Ribes* also being heavily infected. Evidence tending to support the theory of long-distance aecidial spread was obtained when the *Ribes* stage of the rust was found 100 to 110 miles north of the known limit of distribution of the alternate host. *Ribes* infection was also common in the Dry Belt, and in the interior the disease was much more prevalent, 72 infected pines being destroyed compared with 14 in 1922.

Brief records are given of the diseases affecting ornamental plants and shrubs and of miscellaneous plants (chiefly weeds).

McDonald (J.). **Annual Report of the Mycologist for the year 1922.**—*Ann. Rept. Kenya Dept. of Agric. for the year ending 31st December, 1922*, pp. 111–115, 1924.

Further investigations on the disease of flax attributed to *Macrosporium* conclusively demonstrated the very weakly parasitic nature of the fungus. A second fungus isolated in pure culture from the discoloured stems of mature flax plants was identified at the Imperial Bureau of Mycology as *Polyspora lini*, the cause of 'browning' disease in Ireland [see this *Review*, ii, p. 116]. The *Macrosporium* and other fungi were found to invade the tissues destroyed by *P. lini*, thereby masking the true nature of the disease.

The association of various fungi and bacteria with a scabbing and splitting of the pulp of coffee berries was investigated, but none of these organisms could be implicated as the cause of the disturbance. This was subsequently attributed to the action of the heavy rains following previous attacks by an insect, the dead areas being unable to expand at the same rate as the rest of the berries and consequently rupturing.

An important coffee disease causing desiccation of the berries is under study, but no definite statement as to its origin can be made at present.

Two proprietary sprays were tested against leaf disease of coffee

[*Hemileia vastatrix*], neither of which has proved so effective or economical as the carbide mixture [see this *Review*, i, p. 51] in general use for the purpose.

Two varieties of wheat which gave poor results were found to be affected on the ears by a species of *Fusarium*.

Other fungous diseases new to the Colony or definitely identified for the first time included rice blast (*Piricularia grisea*) [*P. oryzae*], fruit scab of guava (*Glomerella psidii*), *Engleromyces goetzei* on bamboo, and *Fomes yucatanensis* on olive.

A mottling of sugar-cane leaves greatly resembling mosaic, but definitely ascertained to be distinct from the disease, was probably due to physiological causes.

Report on the Department of Science and Agriculture, British Guiana, for the year 1922, 45 pp., 1924.

The following references of phytopathological interest are contained in the Report.

Bud rot of coco-nut palms appears to be on the increase on the West Bank, West Coast, and East Coast, Demerara. Defective drainage adds considerably to the spread of the disease.

The witches' broom disease of cacao [*Marasmius perniciosus*] is still very prevalent in the Colony, but a decline was observed in the incidence of the *Marasmius* disease of sugar-cane and in collar rot and knot of citrus.

Sudan grass [*Andropogon sorghum sudanense*] was attacked at the flowering stage by a fungus identified as *Colletotrichum falcatum*. Cutting back and manuring are recommended for the control of the disease.

SHARPLES (A.). **Annual Report of the Mycologist for 1922.**—*Malayan Agric. Journ.*, xi, 10, pp. 267–272, 1923.

A material reduction in the incidence of brown bast of rubber in Malaya has been shown to result from a less drastic tapping system. Thus, alternate daily tapping on the same length of cut causes far fewer cases of the disease than daily tapping. In certain months brown bast development is practically nil, its inception apparently depending on a 'trigger action', which produces a sudden spurt during a given period. This feature has been observed on over 20 plots in the last three years. In one plot of 50 trees immune for 11 months definite evidence was secured that the sudden appearance of the disease coincided with an increased yield. The extension of brown bast can be prevented on individual trees by a deep cut to the wood or by a sufficiently wide bridge of renewing bark. In its downward extension the disease is generally impeded or even arrested at the line marking two panels of bark of different ages. Bad yielders were found frequently to be as severely attacked as good yielders. Brown bast appears to be an exhaustion phenomenon; this explanation would reconcile previously conflicting laboratory and field observations.

Mouldy rot [*Sphaeronema* sp.] has been adequately controlled for two years by agrisol at an annual cost of \$1.26 [about 2*s.* 11*d.*] per acre. Owing to its peculiar spore development, however, there is little chance of eradicating it.

A new species of *Helminthosporium* was obtained, which was capable of causing slight damage to young rubber plants.

Evidence is accumulating to show that in Malaya bud rot of coco-nut and oil palms [*Elaeis guineensis*] is a secondary symptom following insect attacks and not to be confused with the epidemic disease due to *Phytophthora*. Stem-bleeding disease of coco-nuts associated with a salmon-pink discoloration of the trunk, white ants, and the presence of *Thielaviopsis ethaceticus* [*T. paradoxa*], has been investigated on several estates. The first-named symptom appears to be the most important and the others secondary. Inoculations with pure cultures of *Thielaviopsis* gave negative results. Black spot of petioles and leaf stalks of a coco-nut was found to be associated with a species of *Spongospora*, although from a casual inspection the diseased tree appeared to be suffering from an attack of *Pestalozzia palmarum*.

A kind of bud rot was investigated on young oil palms up to two years old. The disease begins with the collapse of the third or fourth leaf from the centre, followed by that of the outer ones. The central leaves remain healthy and finally a set of new leaves is produced surrounded by the collapsed external ones. No organic cause has been demonstrated, and it is suggested that the disease is a form of incipient bud rot, in which, owing to the rapid growth of the central leaves, the affected area is carried away from the healthy portion.

Roselle fibre (*Hibiscus sabdariffa* var. *altissima*) has been attacked by a bacterial disease of the vascular bundles, while the hyphae of a Phycomycete were found in affected roots.

Arghan fibre [*Ananassa* sp.] was attacked by a disease, presumably bacterial, which was successfully controlled. A new collar disease, associated with *T. paradoxa*, has since appeared on the same host, probably as a result of the wet soil conditions.

Anstead (R. D.). **Report on the operations of the Department of Agriculture, Madras Presidency, for the official year 1922–23,** 30 pp., 1 map, 1924.

The following references of phytopathological interest are contained in this Report.

Further work on rice 'blast', caused by *Piricularia* [*oryzae*], showed that the fungus is capable of infecting wheat but no other plant tested.

Negative results were obtained from an elaborate series of manurial experiments with a view to the control of *Phytophthora meadii* on *Hevea* rubber. Certain individuals show constant resistance to the disease, and the reason of this quality is being investigated. It has been definitely ascertained that in the type of *Phytophthora* attack which causes die-back of young rubber trees the fungus is incapable of hibernation, and the removal of dead shoots hitherto recommended is thus rendered superfluous.

Owing to the application of the Pest Act and to the increasing interest taken by Indians in plant protection, there has been a steady decline of palm bud rot [*Phytophthora palmivora*] in the Godavari district.

Considerable damage was caused in South Malabar by the

'mahali' disease of areca nuts [*Phytophthora arecae*]. Spraying should be carried out before the fruit branches are attacked by the fungus.

A number of spraying demonstrations were given during the year. Coffee nurseries were sprayed in several districts for protection against leaf disease [*Hemileia vastatrix*] and *Cercospora* [*coffeicola*]. Turmeric was sprayed with satisfactory results against *Vermicularia* [*curcumae*], and demonstrations were also given of a treatment for the control of citrus scab. The spraying of vines against mildew [*Uncinula necator*] has now become a recognized part of the routine work of the vine-growers.

ROUART (E.). **Visite aux Stations expérimentales de graniculture italiennes.** [A visit to the Italian cereal experiment stations.] —*Journ. d'Agric. Prat.*, lxxxviii, 6, pp. 113–116; 7, pp. 133–134; & 8, pp. 150–152, 3 figs., 1924.

In June 1923 the author (President of the Agricultural Bureau of the South-west of France), together with a party of scientists, inspected the Italian cereal experiment stations at Rieti and Bologna. At the former place Prof. Strampelli is engaged in the work of selection of rust-resistant varieties of wheat, among which may be mentioned Carlotta Strampelli (also fairly widely cultivated in France, where it has a tendency to revert to the characteristics of one of its parents, Rieti or Massy); Ardito, a hybrid of the Dutch Wilhelmine (Rieti 21) and the Japanese Akagomughi; and a selection of Giapponesi, which only takes 100 days to ripen. Other rust-resistant varieties obtained by selection are Grégoire Mendel, Cervaro, Luigi, Apolio, Dauno, and Riccio.

The main object of the Bologna station is the general improvement of cereal varieties, especially in relation to their environment. Some of these, notably Rieti No. 11, and families 12 and 33 (Cologne selections), are also resistant to rust.

BURTON (J. G. L.). **Annual Report of the Plant Breeder.**—*Ann. Rept. Kenya Dept. of Agric. for the year ending 31st December, 1922*, pp. 117–122, 1924.

The behaviour towards rust (*Puccinia graminis*) and other important characters of the 200 varieties of wheat sown at Kabete in 1921 were noted. Rust was extremely prevalent during the period under review, many varieties being entirely destroyed and all undergoing a very severe test. About 80 varieties were only slightly affected, some to a negligible extent, and by the end of 1925 it is hoped to have up to 240 bushels of these wheats ready for distribution.

All the varieties which displayed resistance at Njoro in 1921 were again tested, many giving satisfactory results, though inferior to those obtained at Kabete. About 30 crosses were made at the latter station during 1922, mostly with a view to improving a variety similar to the rust-resistant type of Cross xi. The following crosses were also made in the hope of producing a wheat for districts affected both by *P. graminis* and *P. glumarum*: Red

Egyptian (resistant to *P. graminis*) × White Fife, × Red Fife, × Marquis, and × Equator (all resistant to *P. glumarum*).

All the oats grown at Kabete were practically destroyed by rust.

Some general observations are appended on the constitutional characters of the four commercial varieties of wheat cultivated in Kenya, namely, Equator, Cross xi (Rieti × Red Fife), Bobs-Rieti, and Cross 13/5, with notes on the relative prevalence in different districts of *P. graminis* and *P. glumarum*.

LEIGHTY (C. E.) & TAYLOR (J. W.). **Electrochemical treatment of seed wheat.**—*U.S. Dept. of Agric. Circ.* 305, 7 pp., 1 fig., 1924.

The results of experiments carried out at Arlington (Virginia) from 1920 to 1922 on the electro-chemical treatment of winter wheat seed by the so-called 'Wolfryn' process (*Journ. Min. Agric.* xxvi, p. 971, 1920) showed no improvement in the vigour or yield of the plants, or in freedom from disease. Leaf rust (*Puccinia triticina*) was equally severe, both in 1921 and 1922, on treated and untreated plots, no other diseases being present to any noticeable extent. The grain yield from treated plots averaged 1·1 bushel per acre less than that from the untreated controls.

DUCOMET (V.) & FOËX (E.). **Observations sur les rouilles des céréales.** [Observations on cereal rusts.]—*Journ. d'Agric. Prat.*, lxxxviii, 7, pp. 130–132, 1924.

The early spring of 1923, following an unusually mild winter, was characterized by an excessively severe attack of yellow rust of wheat (*Puccinia glumarum*) in the Parisian basin, central France, and elsewhere. With this was associated an early outbreak of *Erysiphe graminis*, the perithecia of which were observed in Eure-et-Loire on the 3rd April. The varieties Wilhelmina, Allies, Svalof's Soleil II, and Trésor Geffroy were highly resistant to the rust, while Svalof's Pansar and Upsala were immune. After a hot, dry spell in early July the fungus appeared only on late-maturing varieties, which were also attacked by *P. triticina*.

It was observed in certain cases that different plots of the same variety were attacked with unequal intensity. This might in some cases have been due to an accidental admixture of seed, but more usually could be accounted for by variations in the date of sowing. In spring wheats, late-sown plots are apt to be less severely attacked than early-sown. *P. glumarum* in France and *P. triticina* in Switzerland are especially liable to occur with extreme severity on autumn wheats sown in the spring. Heavy infection may also be expected as the result of premature sowing of autumn wheat (August to September).

The authors believe that varietal susceptibility to rust must be considered not only in relation to environmental factors (Wilhelmina, for instance, was susceptible in Zealand and resistant in the Parisian basin), but also to those of periodicity in the life-cycle of the plant. Thus at Courcelles (Seine-et-Marne) the first pustules of *P. glumarum* appeared on Carlotta Strampelli on 23rd March, Bon Fermier (which was eventually far more susceptible) showing no

signs of infection till three weeks later. At Grignon, Goldendrop was heavily infected at the beginning of April and practically free from the disease by the end of May. Varietal susceptibility, moreover, is by no means a constant factor in different years. Further instances are cited to demonstrate the instability of varietal reaction to rust under diverse conditions.

P. triticina did not develop to any serious extent during 1923. It was observed, however, as early as mid-April on *Triticum dicoccum dicoccoides*, instead of (as is usual) in the second half of June. It was practically absent at Grignon on Bon Fermier, non-lodging, and Manitoba (which were severely infected by *P. glumarum*), attacking them with great severity, however, in the Jura, Haute-Savoie, and other districts where *P. glumarum* was little in evidence.

FARIS (J. A.). **Factors influencing infection of Hordeum sativum by Ustilago hordei.**—*Amer. Journ. of Botany*, xi, 3, pp. 189–213, 2 pl., 4 figs., 3 diag., 1924.

A series of experiments was carried out at the Brooklyn Botanic Garden to ascertain the relative importance of the various factors governing the infection of barley (*Hordeum sativum*) by covered smut (*Ustilago hordei*).

Numerous preliminary investigations had shown that barley seedlings germinated well between P_H values of 5 and 8, at moisture percentages from 30 to 60 of the water-holding capacity, and at temperatures between 5° and 30° C. In a series of constant temperature tests [the technique of which is described], seedlings of Hannchen barley grown from seed infected with *U. hordei* showed a very low percentage of infection at 5° both at 40 and 50 per cent. of the water-holding capacity and at hydrogen-ion concentrations of P_H 5, 6, 7, and 7·8, the maximum (14·5 per cent) occurring at P_H 5 with a 40 per cent. water-holding capacity. At 10° there was a marked increase in infection at every degree of P_H in both moistures; at P_H 7 with 40 per cent. water-holding capacity and at P_H 5 with 50 per cent. the percentage of smutted plants was 65·6 and 82·3 respectively. At 15° the incidence of infection remained high throughout the series, the maximum (71·2 per cent.) occurring at P_H 6 with a water-holding capacity of 50 per cent. At 20° the highest percentages of the constant temperature series were reached in strongly acid soil (73·8 and 83·3) at 40 and 50 per cent. water-holding capacity, with a P_H of 5. At 25° there was a distinct drop in infection, the maximum (58 per cent.) occurring at P_H 5 with 50 per cent. water-holding capacity, while at 30° the highest percentage of infection was only 8·5, which was obtained at P_H 6 with 50 per cent. water-holding capacity.

In another series of experiments the seedlings were kept at 10° for six days, after which the temperature was gradually raised to 25° and then allowed to cool to 15°. The infection percentages were much higher in this series than any reached in the constant temperature tests, rising to 97·9 at P_H 5 with a water-holding capacity of 50 per cent.

In a comparative test of the virulence of infection on vigorous and feeble barley seedlings, the former being grown in neutral soil

(P_H 7) and the latter in acid (P_H 4·6), the better plants were almost as severely attacked as the weakly individuals. Apparently, therefore, constitutional vigour does not enable a susceptible variety, such as Hannchen, to escape infection.

Very variable results were obtained as regards the incidence of infection secured by inoculation with different strains of the fungus, presumably owing to the existence of biologic forms within the species.

WOOLMAN (H. M.) & HUMPHREY (H. B.). **Summary of literature on bunt, or stinking smut, of Wheat.**—*U.S. Dept. of Agric. Bull.* 1210, 44 pp., 1924.

In this very interesting paper a general historical retrospect of the available literature on bunt of wheat (*Tilletia tritici* and *T. levis*) is presented under the following headings: (1) The pre-Tillet period (500 B. C. to A. D. 1755), the authors stating that the disease was known beyond question to Theophrastus and other classical authors. (2) The Tillet to Kühn period (1755 to 1870). (3) The Kühn or modern period (1870 to date).

The bibliography comprises over 400 titles, but does not claim to be complete.

DOYER (LUCIE). **Einige Bemerkungen über den Fusariumbefall des Getreides.** [Some observations on the incidence of *Fusarium* disease of cereals.]—*Angew. Bot.*, v, 3, pp. 160–164, 1923. [Received 1924.]

Referring to Atanasoff's investigations on the *Fusarium* blight of cereals [see this *Review*, iii, p. 201], the author does not accept his criticism of her conclusion [see this *Review*, i, p. 56] that the disease may, under certain conditions, assume a systemic character. It is maintained that, while independent, local infections of the type described by Atanasoff are of general and frequent occurrence, the systemic form observed by the author in 1920 appears as the outcome of abnormally severe infection. Since the dry, hot summer of 1921 no such attacks have been been observed in Holland. Atanasoff's statement that the fungus does not, except in very rare cases, spread from the roots to the first or second node, is based on observations made in the United States and is not applicable to Dutch conditions.

REDDY (C. S.) & HOLBERT (J. R.). **The black-bundle disease of Corn.**—*Journ. Agric. Res.*, xxvii, 4, pp. 177–205, 6 pl. (1 col.), 4 figs., 1924.

In this paper the results are described of investigations carried out since 1919 on a hitherto unreported disease of maize which is extremely prevalent in various parts of the United States.

The most distinctive symptom of the disease is the presence of blackened vascular bundles in the stalks and sometimes in the leaves, while the following abnormalities also occur: excessive sucker production, prolific stalks with ear development at many nodes or multiple ear production at one node; a certain type of

reddening or purpling of the leaves and stalks; barren stalks; and stalks bearing only nubbins [imperfectly developed ears].

High percentages of diseased stalks (46·7 in untreated seed and 42·7 in seed treated with corrosive sublimate) were found to result from planting ears selected from purple stalks. The yield of purple-stalked plants was also reduced (33·4 per cent. with untreated and 20·6 per cent. with treated seed). A reduction in yield of 19·7 per cent. occurred as the result of using seed ears from purple-stalked plants.

Cephalosporium acremonium, the morphological and cultural characters and life-history of which are described and which is stated to be the species referred to *C. sacchari* by certain American authors [see this *Review*, iii, p. 31], has been found closely associated with this group of symptoms, many of which were reproduced by pure culture inoculations. Increased sucker production was a notable feature of the artificial inoculation experiments. Infection being seed-borne and vascular, the blackened fibro-vascular bundles were regarded as the most distinguishing characteristic. Purpling, prolific or barren stalks, nubbin ears, and suckering were observed to be closely associated.

The fungus enters the seed through the vascular system and lives within it until placed under conditions favourable to germination. Infection does not, as a rule, inhibit germination or affect the early vigour of the plant. Grain production is specifically affected and a general blighting sets in towards the end of the growing season.

In one inoculation experiment, comprising over 3,000 plants of Yellow Dent maize, the half inoculated with a pure culture of *C. acremonium* produced 11·4 per cent. less in total yield and 20 per cent. less in marketable maize than the half used as a control. The inoculated plants further showed increases of 144·8 per cent. in the number of suckers, 55 per cent. in purple stalks, 114·3 per cent. in prolific stalks, 42·4 per cent. in nubbin ears, and 55·1 per cent. in barren stalks. A number of strains of Yellow Dent showed varying degrees of susceptibility to the fungus. Comparative inoculation tests with *Aplanobacter stewarti* [see next abstract] showed that the latter did not increase the number of purple stalks, while the *C. acremonium* plots averaged 110·8 per cent. more suckers than those of *A. stewarti*. In general, seed lots susceptible to these two vascular diseases were found to succumb more readily to attack by *Gibberella saubinetii*.

The best control measure will probably be the development of resistant strains of maize within the varieties. Preliminary seed treatment experiments, the results of which are not yet ready for publication, also offer promise of good control.

A bibliography of 50 titles is appended.

RAND (F. V.). **Bacterial wilt or Stewart's disease of Corn.**—Reprinted from *The Canner*, lvi, 10, ii, pp. 164–166, 1 fig., 1923. [Received 1924.]

Bacterial wilt or Stewart's disease of maize [*Aplanobacter stewarti*: see this *Review*, i, p. 208] occurs in the southern and middle United States and has, in a few isolated cases, been reported

as far north as southern Michigan and in Albany, New York. In severe cases the crop may be almost totally destroyed over an extensive area; the author frequently found 90 to 100 per cent. of natural infection in certain varieties in his experimental plots.

The organism produces long, wilted, pale green streaks on the leaf blades which may, in dry weather, turn a uniformly lighter colour. This symptom extends from the point of entry of the parasite (usually the lower part of the plant when infection comes from the seed or any other source during the early stages of growth) until the whole plant wilts and dies. Conspicuous yellowing never results, some traces of green generally persisting even in the dead plants. The tassels may develop prematurely and die before the rest of the plant succumbs. The decisive symptom in the case of freshly cut stems is the exudation from the surface of conspicuous yellowish beads of the viscous bacterial slime filling the sap-conducting vessels and sometimes also the tissues near the base of the kernels and other parts of the plant.

The disease appears to be favoured by a combination of high temperature and heavy rainfall, and the results of planting tests showed the maximum incidence of infection to occur in late June and early July sowings. In every case the higher percentages of disease occurred in the irrigated portions of the plot. Rich, heavy soils were found to contain a higher proportion of wilted plants than poor, sandy ground.

During the past four years both field and greenhouse tests [which are briefly described] failed to demonstrate the over-wintering of the parasite in the soil. Seed transmission, however, has repeatedly been shown to occur, and the difference in the amount of wilt contracted by seed from healthy and diseased stalks is noticeable, though recent experiments have proved this source of infection to be less important than was formerly supposed. The use of clean seed however, is, essential to prevent the spread of the disease into new fields or localities.

Various data, the significance of which is briefly discussed, suggested that some factor other than seed or soil transmission influenced the prevalence of maize wilt, and the results of experiments clearly demonstrated the occurrence of insect dissemination. Plants protected by wire netting from flea-beetles, leafhoppers, and other insects showed 20 per cent. less infection than those exposed to them. In four out of seven tests with the brassy flea-beetle 100 per cent. of infection occurred, and in no case did the incidence of disease fall below 57 per cent. In nearly every case the plants in cages from which insects were excluded showed little or no wilt. Insect dissemination, therefore, is an important factor in the development of bacterial wilt.

The results of variety tests showed that late varieties of sweet corn gave a consistently low percentage of infection (below 10 per cent.), while early ones were extremely susceptible (25 to 57 per cent.). Of the 45 varieties of field maize planted during three seasons, 32 were uniformly free from wilt, the earlier Flint varieties being most liable to the disease. Susceptible varieties may, at present, be safely planted along the Canadian border, while Maine also appears to be free from the disease.

THOMPSON (G. C.). **The Sorghum in Arizona.**—*Arizona Agric. Exper. Stat. Bull.* 98, pp. 47–66, 6 figs., 1923. [Received 1924.]

Brief notes are given (p. 66) on three common diseases of sorghum in Arizona.

Kernel smut [*Sphacelotheca sorghi*] affects all varieties of sweet sorghums and kafir, while milo, hegari, and feterita are more or less resistant. It is stated to be readily controllable by one hour's immersion of the seed in 1 lb. formaldehyde to 30 galls. water.

Head smut [*Ustilago reiliana*], which is apt to cause considerable damage, is frequently overlooked owing to the non-appearance of the heads. There is no known method of treatment except the use of clean seed and suitable crop rotation.

Blight [*Helminthosporium turcicum*], which produces irregular, elongated, yellow (later red and finally black) blotches on the leaves, leaf sheaths, and roots, is much more severe in humid or over-irrigated localities than in arid or semi-arid districts. It is not usually serious in Arizona and may be controlled by burning infected stalks and rotation of crops.

M[ASON] (F. A.). **The red mould of Barley and Malt with some notes on related fungi.**—*Bull. Bureau of Bio-Technology* (Murphy & Sons, Sheen Lane, London), 11 & 12, pp. 78–86, 1 fig., 1923. [Received 1924.]

The species of *Fusarium* which produce the pink or salmon-coloured mould-growths on germinating barley on the growing floor in the malting house are discussed. The moulds first become visible on the endosperm of broken corns, less frequently on the husk of whole corns. Later the growth takes on a more gelatinous appearance, and finally, at the withering stage, small, granular, closely compacted, tuberculate granules of a deeper colour are formed, which remain strongly adherent to the testa of the grain. The tubercles are composed of an enormous number of the characteristic macroconidia. Microconidia and chlamydospores may also be present.

The author states that *F. herbarum*, *F. culmorum*, *F. avenaceum*, *F. scirpi*, *F. redolens*, *Calonectria graminicola*, and the *Fusarium* stage of *Gibberella saubinetii*, which are all parasitic on barley in the field, are likely to be found in the malting house, the first two and *C. graminicola* having been met with by him. The presence of red mould on the malting floor in any quantity is an indication that the crop from which it has been derived has suffered from one or other of the various forms of disease due to *Fusarium*. With regard to the effect produced by the moulds, the author's experience is that contaminated barley has a low germinative capacity and gives an uneven growth on the floor.

MCKINNEY (H. H.), ECKERSON (SOPHIA H.), & WEBB (R. W.). **The intracellular bodies associated with the rosette disease and a mosaic-like leaf mottling of Wheat.**—*Journ. Agric. Res.*, xxvi, 12, pp. 605–608, 8 pl., 1923. [Received 1924.]

This paper gives a brief description of the peculiar intracellular bodies usually found associated with the rosette of wheat and also

with a leaf mottling resembling mosaic which occurs on wheat plants either in association with the rosette disease or independently of it. The presence of these bodies was already mentioned by the authors in their abstract in *Phytopathology*, xiii, p. 41, 1923, and by the senior writer in his paper already noticed [see this *Review*, iii, p. 84].

Although the leaf mottling referred to closely resembles the mosaic diseases of other monocotyledons, it appears to behave somewhat differently in that its causal agent seems to be carried over from year to year in the soil, as soil disinfection with formaldehyde or steam apparently completely controlled it in an experiment at Granite City, Illinois. It is not yet known whether it is a virus disease or whether it is carried by some soil insect or other soil organism. Out of 104 winter wheat varieties and selections grown on soil naturally infected with the rosette and leaf mottling causal agent or agents, only 9·6 per cent. showed definite rosette symptoms, while 86·5 per cent. showed leaf mottling in varying degrees of severity, the latter condition always being present in the strains or varieties affected with rosette. This suggests the possibility that rosette may be a severe form of a disease with a wide varietal range of which leaf mottling may be a milder expression.

The intracellular bodies are found in late winter and in early spring in the crown tissues of the plants affected with rosette, and as the disease progresses the bodies become more numerous and more generally distributed throughout the tissues; they are known to occur in the roots, throughout the crown tissue, in the leaf sheaths, and in the leaves, and as yet have not been found in healthy plants. Usually they occur singly in the host cells, but occasionally two or three may be present in one cell. The bodies vary greatly in shape and in size; they may be round, oval, or irregular, while in long host cells they are generally greatly elongated, and there are indications that their size increases as the host cells grow older. They may be much smaller or larger than the cell nucleus and may be situated either free from or in more or less close contact with the latter, while occasionally they are found partially or entirely surrounding it. Their contents seem to be of a rather homogeneous structure, containing many large and small vacuoles; they appear to be surrounded by a membrane, and there is a strong indication that they consist of alveolar protoplasm. As yet they have not been observed to possess definite independent movement. In fresh material mounted in sterile water moving granules and also elongated flexible bodies were occasionally seen in the vacuoles of the larger intracellular bodies; the movements of the granules could be interpreted as typically Brownian, while those of the elongated bodies are more like those which have been described for the mitochondria; after a period of from 36 to 42 hours all motion of the intravacuolar bodies stopped. Structures suggesting nuclei have occasionally been seen, but they were neither constant nor well defined. From the studies made thus far the majority of the cells containing intracellular bodies show no marked difference from the cells free from them, and the host nuclei seem to show little or no abnormality when the bodies are present.

The intracellular bodies in wheat resemble the cell inclusions of unknown nature which are associated with some of the virus diseases of animals and especially certain of the Negri and Guarnieri bodies associated with rabies and small-pox respectively.

RAYBAUD (L.). **Le Cladosporium lauri parasite de la cochenille du Laurier.** [*Cladosporium lauri* a parasite of scale insects of the Laurel.]—*Congrès Path. vég.* (*Centenaire de Pasteur*), *Strasbourg, 1923*, pp. 48–49, 1923.

Scale insects (*Aonidia lauri* Bouché and *Lecanium hesperidum* Forst.) on the leaves of *Laurus nobilis* in Marseilles were found to be attacked by a fungus belonging to the genus *Cladosporium*, which the author also found on leaves free from scales and names *C. lauri.* The mycelium, which is whitish though the conidiophores are brown, develops chiefly on the under side of the leaves, producing chocolate-coloured spots. The conidia on the leaf are mostly one- or two-celled and from 3·5 to 5 by 6 to 8 μ in size. Larger conidia with three or four (occasionally five) cells and somewhat resembling those of *Torula* are also found. Sometimes several simple chains of bicellular conidia arise from a single conidiophore, while the *Hormodendron* type of fructification may develop abundantly. In Raulin's solution the *Dematium pullulans* form is also stated to have appeared.

When the conidia germinate inside a scale insect they usually produce two buds, one of which remains very short while the other elongates without branching, being rather broad at first and then thinner and divided by septa into segments. The latter somewhat resemble a chain of elongated spores, though no abstriction of the segments was ever seen.

The author points out that under comparable conditions of life this fungus develops forms very similar to those of *Apiosporium oleae*, a parasite of scale insects of the olive which he described in 1911 (*Comptes Rendus Soc. de Biol.*, lxxi, p. 214, 1911).

COTTE (J.). **Observations sur une mycose des cochenilles.** [Observations on a mycosis of scale insects.]—*Congrès Path. vég.* (*Centenaire de Pasteur*), *Strasbourg, 1923*, p. 50, 1923.

The author briefly describes the effect of the attack of *Cladosporium lauri* [see last abstract] on the infected insects. The infection, which developed under the influence of autumn rains in 1922, was arrested by a period of dry, windy weather, but reappeared during a further rainy period. The mortality among the scale insects reached in some cases 75 per cent., but on the whole averaged not more than 50 per cent.

Under the climatic conditions of Marseilles the author does not believe that the fungus can be relied upon to control the spread of these insects.

CHIFFLOT (J.). **Maladies et parasites des boutures de Chrysanthèmes.** [Diseases and parasites of Chrysanthemum cuttings.]—*Congrès Path. vég.* (*Centenaire de Pasteur*), *Strasbourg, 1923*, pp. 42–44, 1923.

Among the diseases attacking chrysanthemum cuttings in

nurseries, one of the most destructive is *Septoria chrysanthemi* Cav., of which a spring *Phoma* stage was described in 1909 by Voglino. During the last three years, however, the author has failed to find this stage, only the typical *Septoria* pycnidia being produced. Besides this disease, the cuttings were also extensively attacked by an *Oidium*, but whether this was *O. chrysanthemi* Rabenh., a fungus usually appearing in the autumn, is doubtful. Both diseases can be controlled by sterilizing the soil in which the cuttings are to be planted, sprinkling the surface with a copper fungicide, and immersing the cuttings in potassium pentasulphide prior to planting.

BUDDIN (W.) & WAKEFIELD (ELSIE M.). **'Blackleg' of Pelargonium cuttings.**—*Gard. Chron.*, lxxv, 1933, p. 25, 1 fig., 1924.

'Blackleg' of *Pelargonium* cuttings, usually attributed to *Botrytis*, is especially prevalent late in the season, causing failure to form callus and roots and a blackish discoloration of the base, followed by complete decay.

In 1922 and 1923 evidence was obtained of the presence in diseased cuttings of *Pythium de Baryanum*, which, on the latter occasion, was definitely isolated from infected material. Very little *Botrytis* was found on the affected plants, though prevalent elsewhere in the same greenhouse.

It appears probable, however, that *Botrytis cinerea* sometimes produces similar symptoms, an inoculation experiment at Kew having resulted in infection by that fungus. The lesions produced by *Botrytis* are lighter in colour and firmer than those due to *Pythium*.

In the case of attack by *Botrytis* the best control is likely to be secured by scrupulous attention to sanitary measures, while when *Pythium* is concerned the use of the Cheshunt compound [see this *Review*, i, p. 373] will perhaps be found beneficial.

MCCULLOCH (LUCIA). **A bacterial blight of Gladioli.**—*Journ. Agric. Res.*, xxvii, 4, pp. 225–229, 2 pl., 1924.

A serious disease of gladioli was observed in the Middle West of the United States in 1922, reappearing in 1923 and abating quite suddenly.

More or less angular, translucent spots appear on the affected leaves, accompanied by a copious and viscid exudate which, when dry, forms a thin, brittle layer or small patches on the surface. The leaves are often coated with soil particles which have become embedded in the exudate. The growth of the corms is impeded.

The causal organism, for which the name *Bacterium gummisudans*, n. sp., is proposed, was readily isolated from diseased material. It is a short rod, motile, having one flagellum; capsules present but no spores; Gram negative, non-acid fast; forming a yellow, viscid growth on culture media; gelatine liquefied, nitrates not reduced; optimum temperature about 30° C., maximum 36°,

minimum below 2°, thermal death point near 50°. Its group number is 211.2322523.

Numerous inoculations resulting in successful infections proved that the bacterium isolated from the leaves is the cause of the disease. It gains admission to the tissues by way of the stomata, invading the parenchyma and filling the intercellular spaces and cavities resulting from the destruction of the cell walls.

PIETERS (A. J.). **Clover failure.**—*U.S. Dept. of Agric. Farmers' Bull.* 1365, 24 pp., 5 figs., 4 diag., 1924.

The principal causes of clover failure, i. e. the complete or partial loss of a stand of red clover [*Trifolium pratense*] or the failure to secure a stand after sowing, are enumerated.

In Tennessee anthracnose [*Gloeosporium caulivorum*] has caused serious losses in the crop. Clover raised from seed grown in southern Europe is stated to be more resistant than that from American or north European seed. A resistant variety has been selected by the Tennessee Agricultural Experiment Station.

Stem rot [*Sclerotinia trifoliorum*] is widespread in the United States as far south as North Carolina and occurs also in Canada and Oregon, being responsible for partial failures in the latter State. Root rot, due to an unknown cause, produces failure in Ohio and Washington, D.C. The maximum amount of loss caused by other fungous diseases is estimated at 20 to 25 per cent. Apart from liming, which is the best means of counteracting the fungous diseases of clover, the temporary substitution of another crop, e.g. mammoth [*Trifolium medium*] or alsike clover [*T. hybridum*] or soy-beans, may be recommended.

Barley has been found less injurious as a nurse crop for clover than oats, and brief directions are given for the preparation of the seed-bed and various cultural operations calculated to minimize the failures, which are stated to have assumed alarming proportions in the United States of recent years.

BONAR (L.). **Studies on the biology of Brachysporium trifolii.**—*Amer. Journ. of Botany*, xi, 3, pp. 123–158, 2 pl., 2 figs., 1924.

Brachysporium trifolii, which attacks the leaves and petioles of clover, has been studied by the author as regards its physiological reactions and complete life-history both in culture and on its native host.

The technique of the culture experiments is described in some detail. On certain media, notably heavy oatmeal agar, numerous slender, branched, black, stalk-like bodies were produced. These resembled the early development of perithecia, but at a certain stage a disintegration of the protoplasm set in within the interior cells, resulting in sterile tissue which underwent no further development. Mycelial growth and conidial production are extremely dependent on environmental factors. The optimum temperature for the former was found to be 20° to 24° C., with a minimum and maximum of 6° to 8° and 30° respectively. The mycelium grows

better in the dark or in diffuse light than in the direct rays of the sun. An abundant supply of oxygen is essential to its growth, which was totally inhibited in 1 to 2 weeks in sealed tubes. The degree of humidity in the culture chamber has a very marked effect on growth. An atmosphere approaching saturation conduces to growth at temperatures at which it is normally precluded. The fungus thrives on a slightly acid substratum and requires a plentiful supply of carbohydrates and proteins such as are provided by oatmeal, cornmeal, rice, and the like.

For conidial production the optimum temperature corresponds to that for mycelial growth, the maximum and minimum being 27° and 15° to 16° respectively. In other respects also the reaction of the conidia to environmental factors resembles that of the mycelium, except that a lesser degree of atmospheric humidity is more favourable to their production than saturation.

Protracted growth in culture (28 months) was found to lead to a considerable attenuation of virulence. The results of inoculation experiments with pure cultures of *B. trifolii* on various species of clover showed *Trifolium spumosum*, *T. repens latus*, and *T. incarnatum* to be the most susceptible. The necessary conditions for infection are an extremely high degree of humidity combined with a temperature of at least 75° to 80° F. Owing to the comparative rarity of these conditions in the field, the fungus is not likely to prove of great economic importance.

A distinct albino mutation [see this *Review*, ii, p. 76] was once found in a long-cultivated, pure line of the normal dark-coloured form.

Das Auftreten wichtiger Obstbaumschädiger in der Provinz Brandenburg 1923. [The occurrence of important orchard pests in the Province of Brandenburg in 1923.]—*Beilage Prov. Brandenburg der Deutsch. Obst- und Gemüsebauzeit.*, lxx, 14, pp. 2–4, 1924.

The incidence of American gooseberry mildew [*Sphaerotheca mors-uvae*] in 1923 was very much lower than usual in most of the districts of Brandenburg reporting to the Dahlem (Berlin) Plant Protection Station. Observations on varietal susceptibility and on climatic influences were scanty and contradictory. Sulphur preparations, such as cosan 0·1 per cent., solbar 1 per cent., and potassium sulphide, gave the best control.

Monilia [*Sclerotinia*] disease of cherries [*S. cinerea*] caused extremely severe damage, which is believed to have been correlated with the exceptionally cold and damp spring. In one district the occurrence of thunderstorms during the blossoming was stated entirely to prevent bearing in the Von der Natte variety, the pistils turning quite black. The disease was most prevalent on cold, impermeable soils and in protected situations. Sweet cherries were generally less susceptible than Morellos. The Königin Hortensie, Königliche Amarelle, and Maiherz were reported to be immune, and Schattenmorelle, Ochsenherz, and Lange Lot highly susceptible. The only fungicide to give any promise of successful control was solbar 1 per cent.

BREMER (H.). **Wissenswertes aus der Arbeit in- und ausländischer Versuchsstationen und Institute. IV. Apfelschorfjahre und Wetter.** [Facts worth knowing concerning the work of home and foreign experiment stations and institutes. IV. Apple scab years and the weather.]—*Deutsche Obst- und Gemüsebauzeit.*, lxx, 12, pp. 96–97, 1924.

The results of an analysis of the meteorological data of the Proskau [Silesia] Experiment Station from 1897 to 1901 and from 1904 to 1908 have shown a distinct connexion between the rainfall during the first ten days of May and the incidence of scab (*Fusicladium*) [*Venturia inaequalis*].

According to Ihne's phenological map of Germany, the normal date for the beginning of apple blossoming in the Proskau district is 6th to 12th May. Thus the amount of rainfall during the period about ten days before the opening of the blossoms appears to determine the incidence of the disease, heavy rains at this critical time generally denoting a severe epidemic in the following summer. The corresponding critical period for the Baltic coast and the mountainous regions is the second ten days of May or later, according to situation, and for the Rhenish provinces the last ten days of April or earlier.

The importance of these observations in regard to the spraying schedules is obvious. The best method of control is generally admitted to consist of two or three applications of Bordeaux mixture, shortly before and soon after blossoming, and again (if necessary) three weeks later. In the event of a heavy rainfall about ten days before blossoming, the first (and most important) spray should be given immediately, while if the period be dry the matter is less urgent.

EASTHAM (J. W.). **Fire-blight (Bacillus amylovorous).**—*Brit. Columbia Dept. of Agric. (Hort. Branch) Circ. 66*, 8 pp., 7 figs., 1924.

The history and symptoms of fireblight (*Bacillus amylovorus*) are described, with observations on varietal susceptibility and control. In British Columbia, where the disease was first observed in 1911, it is stated to be confined to the interior of the Province.

FAES (H.) & STAEHELIN (M.). **La maladie cryptogamique des Abricotiers en Valais.** [The fungous disease of Apricots in Valais.]—Reprinted from *Ann. agric. de la Suisse 1923*, 22 pp., 10 figs., 1924.

Stromatinia (*Sclerotinia*) *laxa*, believed by some to be only a specialized form of *Sclerotinia cinerea*, is a very dangerous parasite of apricots in the canton of Valais, causing desiccation and death of the flowers and leaves of the floral spurs, the decay of a portion of the fruit, and the mummification of some of the apricots, which adhere to the tree throughout the winter.

The life-history of the fungus and the course of the disease are described in detail. The first symptom, the appearance of numerous greyish tufts of conidiophores, is observed as early as February on pruning wounds, on cankers produced by the fungus on old wood, and on the mummified apricots on the trees. The conidia developed

on these conidiophores are the source of fresh infections in the spring. The fungus passes from the flowers to the spurs, invading the cambium and causing the desiccation of the branches. New conidia appear on the flowers destroyed by the fungus and attack the developing fruit.

Inoculations, of which the details are given, showed that infection of the flower can take place through the perianth as well as through the stigma. Tests on other fruit trees gave positive results with cherries, browning of the stigmata and styles with pears and plums, and failed with apples and peaches. Cherries have not been reported as suffering from the attacks of this fungus under natural conditions.

The disease is most severe on fertile, well-manured soils, where the trees have an abundance of sap. It may be controlled by drastic pruning, the removal of all decayed material, the excision and painting of cankers, and the application, during the dormant period, of lime-sulphur 1 in 4.

Palmer (R. C.). **Fruit storage problems.**—*Thirty-fourth Ann. Rept. Brit. Columbia Fruit Growers' Assoc. for the year ending December 31st, 1923,* pp. 30–33, 1924.

The preliminary results of apple storage investigations, which are still in progress at Summerland, B.C., showed that fruit ripened faster in non-ventilated storage than when left out in the orchard and protected only from the direct rays of the sun. Adequate ventilation delayed the appearance of Jonathan breakdown, which was also practically absent in fruit picked before 15th October. No connexion was found between breakdown and corky core. Badly water-cored apples placed, unwrapped, in well-ventilated storage showed no trace of the disturbance two months later. Wrapping of the fruit in ordinary paper checked shrivelling but favoured scald. Wrapping in oiled paper prevented scald and delayed maturity. There was as much difference in the keeping quality of apples from different trees grown under the same cultural conditions as between those from trees grown under differing cultural conditions.

Magness (J. R.) & Burroughs (A. M.). **Second Report—Studies in Apple storage.**—*Storage Investigations 1921–1922, Marble Laboratory Inc., Canton, Pennsylvania,* pp. 17–98, 3 pl. (1 col.), 1 chart, 17 graphs, 1923. [Received 1924.]

Fruit of a number of varieties of apples was stored in (1) ventilated crates; (2) standard boxes, unwrapped; (3) ditto, fibre paper wraps; (4) ditto, commercial oil paper wraps [see this *Review*, iii, p. 215]; and (5) ordinary commercial barrels. Apples of each variety in each type of package were stored in (1) ventilated cellars; (2) ventilated cold storage at 35°; (3) ditto at 32°; and (4) unventilated cold storage at 32°.

Most of the varieties showed a rapid softening when placed in cellar storage, some being quite soft in three weeks at 50° to 55°. Softening was much more rapid in all varieties except Yellow Newtown when held at 35° than at 32°. Most varieties are

actually harder after six months' storage at 32° than the cellar fruit after six weeks. This is said to agree with commercial practice, in which there is an increasing tendency to store at lower temperatures, many of the best modern plants being held at 30° to 31°. No consistent effect of ventilation or the type of package could be detected in the rate of softening or ripening of the fruit.

Thick-skinned varieties were able to stand low humidity (below 75 per cent.) without perceptible wilting, but about 85 per cent. relative humidity was necessary to prevent this trouble in the other varieties when stored in open containers (80 per cent. in barrels or wrapped boxes).

Scald occurred very severely in York Imperials and to a moderate extent in Baldwin, Rome Beauty, and Yellow Newtown, especially when packed in barrels. Ordinary wrapped boxes showed more scald than ventilated crates, and more than the oil paper wrapped fruit, at 32°. Both in cellars and at 35° ventilated storage, more scald developed in boxes of fruit in oiled wrappers than in those wrapped in ordinary fibre paper. Distinctly more scald developed in the room held at high humidity and with continuous ventilation than in that maintained at lower humidity and without admission of outside air. In both rooms there was much scald on fruit in the non-ventilated packages.

The skin of immature apples, which are particularly susceptible to scald, is stated to be much less permeable to water vapour than that of ripe ones. The action of ventilation in reducing scald may consist mainly in drying the surface of the fruit.

Soft scald was very severe on Jonathan and Rome Beauty at 32°, even in ventilated crates, and appears to be associated with exposure to low temperatures.

The quantity of decay was much greater in the cellar than in any of the refrigerated rooms, and about twice as high at 35° as at 32°. The fruit stored in boxes and wrapped either in ordinary or oiled paper showed less rot than that in any other type of package.

The section of the paper dealing with the physiological aspects of apple storage comprises, *inter alia*, discussions on respiration in relation to gas composition, skin condition, wounding, the internal atmosphere of the apple, and catalase content; changes in acids and sugars during storage; and flavour and aroma in storage.

MARBLE (L. M.) **Studies in Apple storage.**—*Fourth Rept. Marble Laboratory Inc., Canton, Pennsylvania,* 39 pp., 7 graphs, 1923. [Received 1924.]

The results of an intensive series of investigations conducted during 1922 to 1923 on different types of apple storage are reported.

Three stages in the ripening process are distinguished. (1) An initial change before softening begins, which can be checked if the apples are placed in storage at 32° immediately after picking. (2) A gradual softening, differing in each variety, which can be delayed, but not prevented, by storage at 32°. (3) A soft condition which persists until the fruit is destroyed by physiological breakdown, rots, or moulds.

Immediate storage at 32° not only holds the apples perfectly firm but preserves the distinct tree flavour. This temperature, however, must be continuous, as any break is liable to start the action of the softening forces.

Apples picked on five different dates in October and withdrawn from storage on 15th January showed that those stored in a cellar in ventilated crates were nearly free from scald, entirely free from mould, and showed a negligible percentage of withered fruit, about 90 per cent. being perfect. There was a slight amount of physiological breakdown. Cellar-stored apples in both closed and open barrels showed some scald, but were entirely free from mould. There was about the same percentage of rotten fruit as in the ventilated crates, but no withering. Approximately 70 per cent. of the apples were perfect. The open head barrels were freer from rot than the closed head type. Humidity fluctuated widely, but was estimated at 65 per cent. for the greater part of the time.

Apples stored at 40° without ventilation were nearly all scalded and mouldy, had about the same amount of rot as the cellar-stored fruit, but showed no perfect specimens. The barrel apples were in somewhat better condition than those in crates, open barrels being freer from mould than closed ones. Humidity varied between 85 and 90 per cent.

Ventilated apples stored at 40° in crates showed a slight degree of mild scald and a considerable amount of mould, attributed to unduly solid packing of the crates and consequent hindrance of ventilation. There was rather more rot than in the foregoing cases, and the percentage of perfect apples was small. Severe scald occurred in the apples stored under the same conditions in closed barrels, those in open barrels being practically free from this trouble. On the other hand, the fruit stored in the open barrels was badly moulded, while that in the closed ones showed scarcely a trace. On the removal of the fruit to the cellar the mould entirely disappeared in a week. Humidity ranged round about 65 per cent.

The apples stored with air circulation at 32° immediately after picking were in perfect condition on withdrawal from storage, but a slight trace of scald appeared ten days later. Humidity was about 65 per cent.

Mould appears to depend on two distinct factors, temperature and ventilation. Low temperatures appear to exert a depressing influence and to lessen resistance to scald in certain varieties. Ventilation effectually prevents scald if the temperature is high enough for the variety. Wageners become scalded at 32° under air movement and remain sound at 40° under the same conditions, though without ventilation the percentage of disease is high at 40°. Soft scald is known to be associated with temperatures below 32°, while internal browning of the Yellow Newtown apple [see this *Review,* iii, p. 403] is definitely correlated with temperatures below 36° to 38°. In certain parts of Pennsylvania, York Imperials are stored at 35° under ventilation to prevent scald, which is known to occur if the temperature falls to 32°.

Stoddard (E. M.), Rose (D. H.), & Stevens (N. E.). **Spraying Strawberries for the control of fruit rots.**—*U.S. Dept. of Agric. Circ.* 309, 4 pp., 1924.

At a conservative estimate the annual loss from decay of strawberry fruits in the United States, where the total crop was valued in 1920 at approximately $35,000,000, is stated to amount to 5 per cent. From careful observations in White County, Arkansas, where the value of the crop is estimated at over $1,000,000 per annum, the annual losses are calculated at one quarter of the whole. Even more serious are the losses which occur in transit, the States of Arkansas, Tennessee, and Missouri being chiefly affected.

A series of spraying experiments was conducted in the spring of 1923 at Bebee, Arkansas, on fields which were known to have suffered extremely heavy damage in the previous year. The tests extended over the period 9th March (opening of the buds on the Klondike variety) to 21st April, when the fruit was beginning to show pink. The preparations used were Bordeaux mixture (4–4–50); copper lime dust (15 per cent. dehydrated copper sulphate and 85 per cent. lime and filler); and sulphur dust (93 per cent. sulphur and 7 per cent. filler). Five applications were given to some of the plots, others receiving only one to four.

The fruit was picked on 5th May after nine days of excessively heavy rain, which rendered the control of rot-producing organisms almost impossible. Attention was therefore directed mainly towards the keeping quality of the fruit which appeared sound when picked. The loss from disease in the field was estimated at about 25 per cent. of the whole crop, the causal organisms of the decay (in order of importance) being undetermined species of *Phytophthora*, *Rhizoctonia*, *Pezizella*, and *Botrytis*.

The effects of the various treatments on the keeping quality of the fruit did not indicate any very distinct superiority of one over another. The general results in regard to disease control, however, are regarded as amply justifying treatment with Bordeaux mixture and in some cases the application of dusts.

Savastano (L.). **Manipolazione della poltiglia solfo-calcica (formola della Stazione di Agrumicoltura) e suo uso.** [The preparation of lime-sulphur solutions (formula of the Station for Citrus-growing) and their application.]—*Boll. R. Staz. Sperim. di Agrumic. e Fruttic. Acireale*, 47, 7 pp., 1923. [Received 1924.]

Detailed directions are given for the preparation of lime-sulphur in accordance with a formula introduced by the Experiment Station, Acireale, Sicily. Its ingredients are: water 100 litres, sulphur 20 kg., and lime 10 kg. A concentrated solution is first prepared by boiling for not more than 50 minutes, care being taken to replace water lost by evaporation so that the volume of the liquid never sinks below 100 litres. For spraying purposes this mixture is diluted with water, the proportion being 100 : 6 to 8 for summer treatment and 100 : 10 to 12 for winter treatment. This applies to trees in foliage; for leafless trees the strength can be raised to 100 : 20 to 25.

The mixture has been found efficacious for the control of scale insects, sooty moulds, and loquat scab [*Fusicladium eriobotryae*]. Spraying should be suspended on hot days, or during the hot hours of the day. In practice, the best time for spraying in the case of sooty mould is the dry period of summer, but the grower will have to use his discretion. For loquat scab the treatment, which is prophylactic, consists of an application in December and one in January. The author describes a contrivance to ensure the efficient spraying of the upper surface of the leaves in the crown of the tree, which consists of a long, curved spraying rod and has given satisfactory results in practice.

Degrully (L.). **Pour augmenter le pouvoir mouillant des bouillies cupriques.** [To increase the adhesive powers of copper mixtures.]—*Prog. Agric. et Vitic.*, lxxx, 52, pp. 633–634, 1923; lxxxi, 4, p. 83, 1924.

The addition of silicic sol to fungicide solutions to increase their adhesive powers has previously been advocated in France, and experiments carried out at Villefranche-sur-Saône in 1890 are stated to have been satisfactory. The employment of this substance is in many cases preferable to soap, resin, molasses, &c., as there is no reaction in the mixture, and its cost also compares favourably with the substances referred to. A process for its preparation recently patented by a French industrial concern is as follows: dissolve 100 gm. of bichromate of potash in 100 l. of water, add 500 c.c. of silicate of soda at 30° Beaumé and 1·5 l. of 10 per cent. sulphuric acid, stirring well while pouring in the latter; leave standing for 24 hours, when the silicic sol is formed and the solution has attained its maximum adhesive powers. It is superior to a solution of 100 gm. of gelatine in 100 l. of water, and keeps its 'wetting' qualities for several weeks.

Two other methods of preparation are also covered by the same patent and are detailed.

Gard (M.). **Les bouillies cupriques modifient les propriétés physiques de la surface des feuilles sur lesquelles elles sont appliquées.** [Copper mixtures modify the physical properties of the surface of the leaves sprayed with them.]—*Congrès Path. vég. (Centenaire de Pasteur), Strasbourg, 1923*, pp. 57–60, 1923.

The author attributes the efficacy of copper sprays (copper acetate, Burgundy and Bordeaux mixtures) against vine mildew [*Plasmopara viticola*] in part to the fact established by him in a series of experiments, some details of which are given, that sprayed leaves dry after a rain much more rapidly than unsprayed ones. In his experiments sprayed vine leaves dried completely in from 15 to 20 minutes, while the conidia of *Plasmopara* require about one hour to germinate under the most favourable temperature conditions. The rapidity of drying is explained by a modification of surface tension on the sprayed leaves, which prevents the rain from collecting in drops or large masses such as would take a long time to evaporate. Since infection takes place chiefly on the under side of

the leaf, the necessity of spraying vines, especially in nurseries, on both sides of the leaves is emphasized.

GARD (M.). **Les bouillies cupriques modifient les propriétés physiques de la surface des feuilles sur lesquelles elles sont appliquées. (Deuxième note.)** [Copper mixtures modify the physical properties of the surface of the leaves sprayed with them. (Second note).]—*Rev. Path. Vég. et Ent. Agric.*, x, 4, pp. 332–336, 1923.

Developing the views expressed in his earlier paper [see last abstract], the author states that bright blue copper mixtures, i.e. those containing a high percentage of lime, lower the surface tension on the vine leaves and ensure a uniform spread and more rapid evaporation of rain water on the whole surface, thus preventing the conidia of *Plasmopara* from germinating. When sprays containing less lime are used, some drops of water may be formed on the leaves, but the zoospores are killed in such drops.

ZIPPELIUS (H.). **Verbesserte Kupferkalkbrühe.** [Improved Bordeaux mixture.]—*Deutsche Obst- und Gemüsebauzeit.*, lxx, 5, pp. 37–38, 1924.

The practice of adding an excess of lime to Bordeaux mixture is deprecated. Not only is the adhesiveness of the mixture reduced, thereby necessitating more frequent applications, but the intensive shading of the leaves by the preparation impedes assimilatory activity and consequently delays development. The writer has observed the latter phenomenon, not only in vineyards, but also on greenhouse tomatoes attacked by brown spot [mould: *Cladosporium fulvum*]. The application of Bordeaux mixture controlled the disease but simultaneously retarded the maturity of the fruit.

Excellent results were given in the control of late blight of potatoes (*Phytophthora infestans*) by the use of kurtakol [see this *Review*, ii, p. 533]. The convenient and economical application of this preparation, together with its great adhesiveness and excellent keeping qualities, render it a most valuable means of control. Its cost is about equal to that of pure copper sulphate, but it works out far more cheaply owing to the above-mentioned advantages.

Zuckschwerdt's opinion that the adhesiveness of Bordeaux mixture is increased by the addition of magnesium sulphate [see this *Review*, iii, p. 220] is doubtless correct, but it must be remembered that this process necessitates the use of almost twice as much lime as usual in order to secure the decomposition of the magnesium sulphate.

KUSUNOKI (M.). **On the germicidal action of hydrosol of copper.**—*Journ. of Biochem.* [*Tokyo*], iii, 1, pp. 1–13, 1923.

The results of experiments [details of which are given] with copper hydrosol (copper-Yemorisol) on bacterial suspensions of *Bacillus coli* showed that the germicidal action of the preparation rests exclusively upon the copper ions ionized from both copper oxide and carbonate produced from colloidal metallic particles in

the presence of atmospheric gases. Colloidal particles of pure metallic copper have no direct bearing on this action.

The bactericidal action of the dialysate obtained by dialysis of copper-Yemorisol was strongly influenced by the addition of N/10 acetic or hydrochloric acid and N/10 sodium hydroxide at the rate of 2 c.c. per 10 c.c. dialysate, total inhibition occurring at P_H 4·9 or below and at P_H 7·7 or above.

Any process which reduces the dissociation of copper carbonate, such as saturation with carbon dioxide or the addition of alkali solution, hydrosulphuretted water, and the like, was found to counteract the germicidal action of the dialysate obtained from copper-Yemorisol.

A colloidal solution of metallic copper, whether prepared by electrical or chemical methods, is rapidly oxidized to copper oxide sol on contact with oxygen. The presence of carbon dioxide in the atmosphere further induces the production of copper carbonate, which is more soluble than copper oxide. The greenish-blue solution obtained in ordinary air destroyed all bacteria within an hour; the deep blue one obtained in an atmosphere of oxygen showed corresponding activity in two hours, while the red solution which results when kept under hydrogen showed no bactericidal tendency at the end of that time. The strong germicidal action of the solution exposed to the air is stated to be due, therefore, not only to the oxidation of the colloidal copper, but also to the increase in the amount of copper ions by the production of copper carbonate.

Cremer (J.). **Erfahrungen mit Solbar.** [Experiments with solbar.]—*Deutsche Obst- und Gemüsebauzeit.*, lxx, 16, p. 178, 1924.

The following experiments were conducted with 1 per cent. solbar in 1922 and 1923. Two applications at a week's interval for the control of apple mildew [*Podosphaera leucotricha*]. Very good results were obtained.

Two applications at a fortnight's interval for the control of rose mildew [*Sphaerotheca pannosa*], which occurred in a particularly virulent form in 1923. All traces of the disease disappeared after the second application.

One application against mildew of cinerarias [? *Erysiphe cichoracearum* or *Bremia lactucae*] was completely successful, the disease being checked at an early stage.

Leaf curl of peaches [*Exoascus deformans*] yielded to the treatment only after three applications and presumably requires a stronger concentration.

Kessler (B.). **Beobachtungen über die Wirkung verschiedener Bekämpfungsmittel.** [Observations on the action of various disinfectants.]—*Deutsche Obst- und Gemüsebauzeit.*, lxx, *Sondernummer* 14 b, pp. 155–156, 1924.

This paper has been compiled from the records furnished by two practical Rhenish agriculturists of their experiments with various fungicides and insecticides in 1922 and 1923.

At Bamberg good results in the control of apple mildew (*Podo-*

sphaera leucotricha) were obtained by the use of 1 per cent. solbar, 0·05 per cent. colloidal sulphur (de Haën), sulphur at the rate of ¼ kg. per tree, and 2 per cent. (afterwards diluted to 1 and 0·5 per cent.) lime-sulphur mixture (de Haën).

At Coblenz the disease was well controlled in 1922 by sulphur, oidal, elosal, and sulphuring with the Rota generator. In 1923, when infection was exceptionally heavy, only elosal maintained its reputation.

Fusicladium [*Venturia inaequalis*] was admirably controlled at Bamberg by 1 per cent. Bordeaux mixture to which 50 gm. of sugar per 100 l. were added to secure adhesion, and by 1 per cent. kurtakol mixed with a little lime. One per cent. nosperal mixed with lime was slightly less efficacious than the foregoing, while solbar and lime-sulphur proved definitely unsuitable for the control of scab.

DUTTON (W. C.) & WELLS (H. M.). **Some physiological effects of Bordeaux.**—*Proc. Amer. Soc. Hort. Sci. 1923,* pp. 277–281, 1924.

Certain physiological effects of Bordeaux mixture, which are stated to be very imperfectly understood, are here discussed in relation to cherry and apple trees. Two distinct effects have been observed at the East Lansing (Michigan) Agricultural College, namely, a reduction in the size of the cherries and some apparent influence on the frost resistance of apple and cherry leaves.

In 1921 the fruit of Montmorency and English Morello cherry trees sprayed with Bordeaux mixture was smaller than that on those treated with lime-sulphur, sulphur dust, or copper sulphate dust. In 1922 the largest cherries were borne on dusted trees, and the smallest on those sprayed with Bordeaux, the controls being defoliated by leaf spot [*Coccomyces hiemalis*]. The trees sprayed with lime-sulphur yielded intermediate-sized fruit. The reduction was more pronounced in English Morellos than in Montmorency. Similar results were obtained (on Montmorency only) in 1923, in which year a hydrated lime spray also caused a reduction in the size of the cherries. In 1923, when the reduction in size of Bordeaux sprayed fruit was much greater than in 1922, there was a lower rainfall than in that year.

Several investigators have shown that Bordeaux mixture increases transpiration, and during the summer of 1923 this aspect of the treatment was investigated on English Morellos; it was found that the greatest loss of water in transpiration occurred in shoots sprayed with Bordeaux mixture. After 24 hours the cherries attached to the latter were badly wilted, while those on untreated shoots showed little sign of wilting. This would indicate that leaves sprayed with Bordeaux have a greater capacity for drawing water from the green cherries than untreated leaves.

In another test shoots were cut from the trees, the leaves removed, the cherries coated with paraffin, and the amount of water absorbed by each cherry calculated. It was found that the fruit on Bordeaux sprayed shoots took up over seven times as much water as those on untreated shoots. This appears to indicate

a deficiency of water in the Bordeaux sprayed cherries due to its previous extraction from them by the leaves.

In October 1923 an apparent decrease in the frost resistance of the foliage of Baldwin and Red Canada apples and of Montmorency cherries treated with Bordeaux mixture was observed. The treated limbs succumbed to a series of severe frosts while the controls and those treated with lime-sulphur were unaffected. The factors chiefly responsible for this condition have not been determined, but are believed to be possibly connected with some effect of the Bordeaux mixture on the composition of the cell sap or the radiation of heat.

SCHEINPFLUG (E.). **Erfolge und Erfahrungen mit der Saatbeize 'Uspulun'.** [Results and experiments with the seed steep uspulun.]—*Deutsche Obst- und Gemüsebauzeit.*, lxx, 16, pp. 177–178, 1924.

Since 1919 the writer has obtained good results in the disinfection of various vegetable seeds with 0·25 per cent. uspulun, the duration of immersion being 2 hours or more for peas, kidney and runner beans, spinach, beetroot, and the like, and half an hour only for the more sensitive cabbage, onion, tomato, and carrot seeds. The treated seeds are dried in linen bags either in the open or in a heated room, according to weather conditions.

Uspulun has proved particularly effective in accelerating the germination of carrots and promoting an early development of the root system. It also prevents anthracnose of beans [*Colletotrichum lindemuthianum*] and of peas (*Ascochyta pisi*).

Interesting results were obtained in a soil disinfection experiment conducted with uspulun in 1923. Of two frame beds, each measuring 15 sq. m., one was treated early in March with a solution of 50 gm. uspulun per 10 l. of water and the other left untreated as a control. The white cabbage seed destined for the disinfected bed was also steeped in uspulun. The treated seed in the disinfected bed made excellent progress and was ready for planting out at least ten days before the usual time; this is particularly advantageous in market gardening. The untreated seed in the non-disinfected bed was backward and developed poorly. Similar experiments were successfully carried out in the field with red and Savoy cabbage, the seedlings being ready for planting out a week earlier than usual.

MÜLLER (H. C.), MOLZ (E.), & MÜLLER (K.). **Ueber die ertragreiche Wirkung von Beizmitteln.** [The stimulatory action of disinfectants.]—*Deutsche landw. Presse*, li, 4, p. 27, 1924.

The results of further investigations on the fungicidal action of various preparations at the Halle Experiment Station [see this *Review*, ii, p. 416] are described. The material used in the tests consisted of slightly infected Hohenheim wheat following potatoes in a field which had received a complete fertilizer and lime. The seed was treated with (*a*) germisan, immersion for 30 minutes in 0·25 and 0·5 per cent. respectively; (*b*) uspulun, immersion in 0·5 per cent. for 1 hour; (*c*) sprinkled with fusariol after washing; and (*d*) kalimat, immersion in 0·33 per cent. for 15 minutes. All

the preparations reduced the incidence of bunt [*Tilletia tritici* and *T. levis*] from 37·4 per cent. in the untreated controls to a trace. The best results as regards increase of yield were given by kalimat (19·05 zentner grain and 43·12 zentner straw as compared with 12·93 and 38·73 zentner respectively from the untreated plot). Germisan 0·25 per cent. was the next best; fusariol gave the smallest increase of grain and a slight decrease of straw; and the remaining treatments were intermediate.

The results of tests conducted in various parts of Saxony with kalimat and germisan and submitted to the writers showed that in all cases the yield was increased by both preparations, kalimat giving uniformly slightly higher figures than germisan.

Trzebinski (J.) & Minkiewicz (S.). **Quelques mots sur l'organisation et l'activité de la section de la protection des plantes cultivées et de la section d'entomologie de l'Institut National Polonais d'Économie rurale de Pulawy.** [A few words on the organization and activity of the section for the protection of cultivated plants and of the entomological section of the National Polish Institute of Agronomy at Pulawy.]—*Congrès Path. vég. (Centenaire de Pasteur), Strasbourg, 1923*, pp. 34–35, 1923.

The National Polish Institute of Agronomy at Pulawy was founded in 1918 to replace the former Russian High School of Agriculture and Forestry at Novo-Alexandria. It is subdivided into sections and subsections, of which the section for the protection of cultivated plants (under Dr. Trzebinski) and the section of entomology (under Dr. Minkiewicz) deal with research and practical work connected with various pests and diseases of crops in Poland. A short list is given of the principal investigations so far conducted and also of the papers published by both sections.

Chaptal (J.). **Les avertissements agricoles et la phytopathologie.** [Agricultural intelligence and phytopathology.]—*Congrès Path. vég. (Centenaire de Pasteur), Strasbourg, 1923*, pp. 71–74, 1923.

After urging a closer co-operation of meteorologists and phytopathologists in the complex problem of plant protection in the broadest sense of the word, the author describes the working of the regional Station of Agricultural Intelligence at Montpellier [France]. Situated in a vine-growing region, the work of the Station is concerned mainly with this crop. The staff includes a biologist and a physicist, the latter being in charge of the meteorological observations, which are recorded several times a day. These records are collated with the reports of 59 outposts in the Montpellier region and with wireless reports from other parts of France and from abroad. Biological observations at the Station are made in the laboratory, in the hothouse, and in the field, the Station having enough land to allow of growing on a field scale all the chief crops cultivated in the region.

On the basis of the data thus collected the Station issues daily cipher telegrams to its subscribers, giving information regarding the appearance of fungous diseases and insect pests, and the opportuneness of applying fungicidal or insecticidal treatment and

the like. Any exceptional meteorological occurrence in the region, the knowledge of which may be of use to the agriculturists, is also notified. Priority rank is given to these wires at exceptionally low rates, the subscription being 50 francs a month for private persons and 20 for communal bodies. Some of the subscribers in their turn pass on the information received by them by various means, such as optical or sound signals, &c. In case of need this daily service is supplemented by explanatory notes issued by the Station to its subscribers and to the local press. The establishment of a network of wireless stations for the reception and diffusion of the information is now under consideration.

HARTLEY (C.) & RANDS (R. D.). **Plant pathology in the Dutch East Indies.**—*Phytopath.*, xiv, 1, pp. 8–23, 3 figs., 1924.

The study of diseases of plants in the Dutch East Indies has been stimulated from time to time by the epidemics which have caused the country severe losses. The coffee leaf disease (*Hemileia* [*vastatrix*]) in 1880 and 1890, the sereh disease of sugar-cane, tobacco wilt (*Bacillus solanacearum*), and brown bast of *Hevea* rubber were all influential in bringing about the establishment of experiment stations, supported chiefly by the planters themselves, but aided in some cases by very small annual government subsidies. There are ten such stations now in existence, situated as follows: at Medan (Sumatra) for rubber, oil palm, coffee, and all other plantation crops except tobacco; at Buitenzorg for tea; at Djember for tobacco, rubber, coffee, and other 'hill cultures'; at Buitenzorg for the chemistry and physical properties of rubber; at Medan and at Klaten for tobacco; at Pasoeroen (with branches at Semarang and Cheribon) for sugar-cane; at Malang for rubber and coffee; at Salatiga for rubber, coffee, cacao, nutmeg, and coca; and at Buitenzorg for rubber. In addition, a number of the larger plantation companies have research departments of their own. Government pathological work is now limited to the Instituut voor Plantenziekten at Buitenzorg, although other subdivisions of the Department of Agriculture, as the quinine station, the general experiment station, the forestry experiment station, and the Government rubber plantations also engage more or less in pathological work.

The authors briefly note some of the more important investigations which have been carried out in the Dutch East Indies, mentioning particularly those on *Phytophthora nicotianae*, *P. faberi*, *P. cinnamomi*, brown bast of rubber, *Bacterium solanacearum*, blood disease of bananas, *Sclerospora* on maize, diseases of quinine, of peanut, and of potato, and call attention to the almost complete absence of the bud rot of coco-nuts. Forest pathology has been almost confined to a study of some non-parasitic diseases in the intensively handled teak forests.

In general, diseases are abundant in Java, especially on recently introduced crops which become attacked by parasites found on native hosts. As an instance of this is cited *Nigrospora javanica*, which causes the glume spot of wheat, and which previous to the introduction of wheat lived on a species of *Panicum* and on rice and maize.

Plant pathology in the Dutch East Indies is still in the reconnaissance stage and does not seem to have the standing with agriculturists that it ought to have, owing mainly to investigations being discontinued before reliable methods of control have been worked out. Insect pests are regarded as much more important than fungous diseases, the Instituut voor Plantenziekten spending four times as much money on the former as on the latter.

A single domestic quarantine is in force completely prohibiting the export of bananas from Celebes on account of 'blood disease'.

MELIN (E.). **Ueber den Einfluss der Wasserstoffionkonzentrationen auf die Virulenz der Wurzelpilze von Kiefer und Fichte.** [The influence of hydrogen-ion concentrations on the virulence of Pine and Fir root fungi.]—*Botaniska Notiser, 1924*, 1, pp. 38-48, 1 diag., 1924.

The author has investigated the influence of hydrogen-ion concentration on the virulence of *Mycelium radicis sylvestris* β, *M. r. sylvestris* γ, *M. r. abietis, Boletus luteus, B. variegatus, B. granulatus, B. badius, Rhizoctonia sylvestris,* and *M. r. atrovirens.*

It was found that all the mycorrhizal fungi proper throve best at a hydrogen-ion concentration of or slightly below P_H 5. They all showed poor development at P_H 7, while *M. r. sylvestris* β and γ also failed to tolerate a concentration of P_H 3·4 to 3·0. This corresponds to natural conditions, under which mycorrhiza are, in general, poorly represented in neutral or slightly acid soils, such as those of the central Swedish forests. They flourish, on the other hand, in the northern forests and other localities with an abundant supply of humus, where the hydrogen-ion concentration fluctuates round about P_H 5. *B. variegatus,* which tolerated high acid concentrations, is often found where the other mycorrhizal fungi are unable to develop.

Both *Rhizoctonia sylvestris* and *M. r. atrovirens* throve equally well in neutral and acid media. The former seldom, if ever, occurs in Sweden, while the latter is widely distributed in all types of forest soil, irrespective of their hydrogen-ion concentration, since it also flourishes in an alkaline medium.

MELIN (E.). **Zur Kenntnis der Mykorrhizapilze von Pinus montana Mill.** [Contribution to the study of the mycorrhizal fungi of *Pinus montana* Mill.]—*Botaniska Notiser, 1924,* 1, pp. 69–92, 7 figs., 1924.

The author carried out a number of synthetic culture experiments [full particulars of which are given] in order to ascertain how far the mycorrhizal fungi of *Pinus montana* differ from those of *P. sylvestris.*

It was found that *M. r. sylvestris* α, β, and γ, isolated from *P. sylvestris* [see this *Review*, i, p. 122], also produced mycorrhiza on *P. montana.* Those formed by *M. r. sylvestris* β were chiefly pseudomycorrhiza, but this is believed to be due merely to the insufficient virulence of the strain. *Boletus granulatus, B. luteus,* and *B. variegatus* also formed mycorrhiza both on *P. sylvestris* and *P. montana,* whereas *B. badius* only produced pseudomycorrhiza.

The latter organism, however, tends to degenerate on artificial media, and its failure to form mycorrhiza on *P. montana* was probably due to this cause rather than to any inherent inability.

Among the Agaricaceae, *Russula fragilis*, *Lactarius deliciosus*, *Cortinarius mucosus*, and *Tricholoma virgata* formed mycorrhiza on *P. montana*, and it is highly probable that other species of the same genera would behave in the same way. *C. camphoratus* formed no mycorrhiza on *P. montana*, though it has been observed to do so on the larch. Negative results were also obtained with *Amanita rubescens*, possibly on account of the low virulence of the strain. *R. fragilis*, *L. deliciosus*, and *C. mucosus* also form mycorrhiza on *P. sylvestris*, and it would appear that the mycorrhizal fungi are largely identical for both species of pine.

Clamp-connexions were observed on the hyphae of *M. r. sylvestris* β and γ and *C. mucosus*, but not on the other fungi examined. *M. r. sylvestris* α and γ, *B. granulatus*, and *B. variegatus*, evidently the most vigorous species, formed extensively ramified as well as simple mycorrhiza.

Nodular mycorrhiza were produced only by *M. r. sylvestris* and *B. variegatus*, though *B. granulatus* showed a slight tendency in the same direction. *B. luteus* was so much weakened by a year's growth on an artificial medium that it was scarcely able to form even simple mycorrhiza.

PORTER (C. L.). **Concerning the characters of certain fungi as exhibited by their growth in the presence of other fungi.** *Amer. Journ. of Botany*, xi, 3, pp. 168–187, 3 pl., 9 figs., 1924.

A study was made of the growth changes induced in certain fungi by the contiguity of other individuals of the same or a different species [see this *Review*, ii, pp. 328 and 566]. Such inhibition may be mutual, or the growth of one individual may be inhibited more than that of another.

The technique in the methods used in the determination of the various types of inhibition, together with the marked cultural and morphological modifications produced in the 132 different organisms tested [a complete list of which is given], are described at some length.

Five degrees or types of inhibition are distinguished, namely, mutual intermingling, overgrowing with inhibition of the underlying organism, slight inhibition, growth around the contending organism, and inhibition at a distance. Illustrations of the last-named type were afforded by two bacteria and a *Gliocladium* when grown in conjunction with any of the species of *Helminthosporium* tested or with a pink *Fusarium*, a *Mucor*, a bacterium, or *Colletotrichum lindemuthianum*.

The inhibitory powers of one of the bacteria tested (a *Bacterium* with the group number 5131–52120–1333) were so marked that wheat seedlings heavily parasitized by *Helminthosporium* in a laboratory test were measurably protected from infection by previous immersion in a broth culture of the organism. Flax seedlings grown in pots were similarly protected from *Fusarium*,

which could only with difficulty pass a layer of earth heavily infected with the inhibiting organism.

A common cause of the inhibitory action observed in certain organisms is believed to be the presence of some product formed during growth. In an experiment carried out to determine the effects of certain chemicals on the growth of *Helminthosporium* hyphae, inhibitions and distortions similar to those produced by the *Bacterium* mentioned above resulted from the proximity of copper sulphate crystals, phenol (crystals and melted), chloramine T crystals, mercuric chloride, and aqueous solutions of copper sulphate (saturated, 75, 50, and 25 per cent.). It will be noted that all these chemicals are known to possess strong germicidal and fungicidal attributes.

On media rich in nutrients, such as cornmeal, dextrose, and Brazil-nut agars, the inhibitions were less pronounced than on plain and washed agars. Variations in the amount of inoculum, time of inoculation, or depth of medium caused little change in type or degree of inhibition.

No tropic reaction was observed in the roots and root hairs of seedlings in the presence of fungi.

A bibliography of 48 titles is appended.

LEPESCHKIN (W.). **The influence of vitamins upon the development of yeasts and molds (contribution to the bios problem).** —*Amer. Journ. of Botany*, xi, 3, pp. 164–167, 1 graph, 1924.

The results of experiments designed to test the influence of vitamins on the development of *Saccharomyces cerevisiae* are briefly described, with references to the work of other investigators on the 'bios' problem [see this *Review*, iii, p. 293].

In a culture in which a single cell of *S. cerevisiae* was present in each drop of a solution containing ammonium sulphate as the source of nitrogen, no development was observed. The addition of peptone or yeast extract to the medium, however, resulted in excellent growth. A minute quantity of vitamin B (0·001 per cent.) was found to suffice for the growth of the yeast. This substance was found to be contained in peptone.

In another test the yeast was grown in a solution of 10 per cent. glucose, 0·1 per cent. asparagin, 0·1 per cent. $MgSO_4$, and 0·2 per cent. KH_2PO_4, with the addition of 0·01, 0·001, or 0·0001 per cent. of vitamin. No important difference was observed after four days between the effect produced in the growth of the yeast by the addition of 0·01 and 0·001 per cent. of vitamin, while the action of 0·0001 per cent. was considerably weaker. The yeast apparently requires only a small quantity of the substance, which it is useless to increase.

Similar results were obtained in an experiment with *Penicillium glaucum*, the entire length of the hyphae of which increased, after $2\frac{1}{2}$ days at room temperature, 200 per cent. without vitamin as compared with 3483 per cent. with 0·01 per cent. vitamin. The culture solution consisted of 50 gm. saccharose, 2 gm. KH_2PO_4, 1 gm. $MgSO_4$, 2·6 gm. NH_4NO_3, and 0·0046 gm. $FeSO_4$ in 1000 gm. water.

It is suggested that the effect of the vitamin may be either catalytic or similar to that of the co-enzyme in the fermentation process.

Picado (C.). **Sur l'action à distance des champignons phytopathogènes.** [On the action at a distance of fungi pathogenic for plants.]—*Congrès Path. vég.* (*Centenaire de Pasteur*), *Strasbourg, 1923*, pp. 28–34, 1923.

After a brief review of the work done by other investigators on the nature of substances secreted or excreted by various parasitic fungi, by which the host tissues of the latter are either injured or killed at some distance from the point of attack, the author details his own experiments with *Verticillium albo-atrum* and *V. duboys*, both parasites of the potato, *Fusarium solani* from the melon, and a saprophytic *Penicillium*. The plants used in the experiments were potato stems and flageolet bean seedlings. The experiments were designed to test the action of both the exotoxins excreted into the culture medium (Richards's solution) and the endotoxins in the mycelium of the fungi.

The results indicated: (1) That the withering of the plants experimented upon, the browning of their vessels, and the destruction of their tissues are not all produced by the same causes. (2) That the pathogenic action of the endo- or exotoxins of a fungus on its usual host plant cannot be gauged from the action of the toxins on other plants. (3) That in general the toxic substances are contained in the mycelium and pass into the culture medium only in old cultures in which a large portion of the mycelium is plasmolysed. (4) That very often the withering of the plants is more accentuated when extracts heated at 100° C. are used than with unheated extracts; this would not happen if the extracts contained true toxins or enzymes. Further experiments showed that this last phenomenon is particularly clear with *Fusarium cubense,* the cause of a banana disease [the 'Panama' disease].

The author then undertook another series of experiments to determine whether the above phenomena were due rather to poisoning than to intoxication in the strict sense of the word. He treated the culture liquid and also the filtered extract of mycelium with an equal volume of absolute alcohol, thus precipitating the albuminoids with all the enzymes and toxins; furthermore, by concentrating at 80° C. for 24 hours the liquid from the crushed mycelium from which the enzymes and toxins had been precipitated as above, he obtained a waxy, brownish, and very hygroscopic residuum containing only the thermostable poisons elaborated by the fungus. Experiments with these extracts on the same plants as before, showed that the heated extract was considerably more potent in producing the withering of the plants than the endoenzymes and endotoxins, and that its action was more electively pathogenic for the plants usually parasitized by the fungus.

In comparing these results with those obtained with fungi parasitizing animals, and recalling that in poisonous mushrooms the toxic substance known as 'Amanita-toxin' is a poison and not a true toxin (as animals have never yet been immunized against it), the author suggests that the action at a distance of certain parasitic

fungi may possibly be due to a chronic poisoning of the plant comparable to the chronic wasting produced in animals by certain fungi. If this were the case, it would be necessary to abandon the search for immunization and to look for antidotes.

Petrescu (C.). **Contribution à l'étude biologique de la flore de Dobrogea et de Moldavie.** [Contribution to the biological study of the flora of the Dobrudja and Moldavia.]—*Comptes Rendus Soc. de Biol.*, xc, 2, pp. 158–160, 1924.

Notes are given on the biological equilibrium assumed in the case of association between the following rusts and their host plants: *Uromyces ononidis* and *Ononis campestre* (*flor. solitaris*); *U. silene ponticae* and *Silene pontica*; *Puccinia stachydis* and *Stachys patula*; *P. elymicola* and *Elymus sabulosus*; *P. graminis* and *Triticum vulgare, Agropyrum glaucum, A. caninum, Avena sativa, Secale cereale,* and *Dactylis glomerata.*

In no case did either partner suffer in any way from the association, each completing its normal life-cycle without obstruction. Further observations will be made on *D. glomerata,* the study of which was interrupted by the dispersal of the grain.

Petrescu (C.). **Contribution à l'étude biologique de la flore de Moldavie.** [Contribution to the biological study of the flora of Moldavia.]—*Comptes Rendus Soc. de Biol.*, xc, 4, pp. 320–322, 1924.

In continuation of these studies [see last abstract] notes are given on the biological association between other rusts and their host plants. In the case of *Uromyces trifolii-repentis* on *Trifolium repens,* the host plant fails to produce fruit and the biological equilibrium is thereby destroyed, the fungus alone completing its life-cycle. In the following cases, however, the biological equilibrium was maintained: *U. trifolii* and *T. ochroleucum, T. pratense,* and *T. pannonicum*; *U. minor* and *T. montanum*; *U. striatus* and *Medicago falcata* (doubtful), *M. media, T. aureum* (*T. agrarium*), *T. campestre, T. filiforme,* and *T. arvense.*

Lindfors (T.). **Einige Kulturversuche mit Fusarium-Arten in Nährlösungen von verschiedener Wasserstoffionenkonzentration.** [Some culture experiments with species of *Fusarium* in nutrient media of varying hydrogen-ion concentrations.]—*Botaniska Notiser, 1924,* 2, pp. 161–171, 4 graphs, 1924.

After a brief review of the work of other investigators, the author describes experiments, conducted at Stockholm during the winter of 1922–23, with (1) *Fusarium minimum* [*F. nivale*], (2) *F. culmorum,* (3) *F. solani,* (4) *F. redolens,* and (5) *F. viticola.* According to the author's unpublished observations, the optimum temperatures for these organisms are (1) 22°, (2) 25°, (3) and (4) 28°, and (5) 26°, but all the tests were carried out at a room temperature of 20° C.

The results of the tests, as expressed in growth curves, showed that the hydrogen-ion concentration of the medium strongly

influenced the development of the organisms investigated. All species throve best at acid concentrations, the optima being approximately as follows: (5) between P_H 4 and 5; (4) P_H 5; (3) P_H 6; (1) between P_H 5 and 6, with a drop on the alkaline side followed by a sharp rise from P_H 7·5 to 9; (2) had two optima on the acid side, at P_H 5 and slightly above P_H 6, and therefore resembles *Gibberella saubinetii* [see this *Review*, i, p. 340] in this respect.

In these tests all the organisms made a certain amount of growth at a wide range of hydrogen-ion concentrations, but under the far less favourable conditions usually found in nature their capacity for development would probably be considerably restricted. An abrupt drop in the growth curve towards the point of neutrality was apparent in all the species, and it is suggested that this fact should be taken into account in the investigation of possible control measures.

WEBER (G. F.). **Potato diseases and insects.**—*Florida Agric. Exper. Stat. Bull.* 169, pp. 103–163, 55 figs., 1923. [Received 1924.]

The following diseases of potatoes are described and figured, appropriate control measures being recommended in each case. Late blight (*Phytophthora infestans*), which was very prevalent in Florida during 1923. Bacterial wilt (*Bacterium solanacearum*), which has recently been found to be very largely disseminated, under Florida conditions, by means of rain and running water carrying the soil infected by disintegrating diseased tubers to healthy plants. Blackleg (*Bacillus phytophthorus*) [*B. atrosepticus*]. Early blight (*Macrosporium* [*Alternaria*] *solani*), which usually appears in Florida with the first approach of warm weather in March and may cause very considerable damage. At this time late blight is beginning to diminish, so that the conditions with regard to these two diseases are the exact reverse of those prevailing in the northern States. Bordeaux mixture 5–5–50 is stated to give good control. Black scurf (*Corticium vagum*), which is very common in Florida on low, poorly drained soils. Southern wilt (*Sclerotium rolfsii*), which is particularly prevalent during rainy seasons. Effective control measures are hard to ensure; roguing and frequent cultivation appear to give the best results.

Mosaic, curly dwarf, and leaf roll are all stated to be common in Florida. Spindle sprout occurs chiefly among the poorer grades of seed. Yellow dwarf [see this *Review*, i, p. 449] has been found only in one isolated field and is so far of no economic importance.

Fusarium wilt (*F. oxysporum*) is widely distributed in Florida, occurring sporadically rather than in centralized areas, while common scab (*Actinomyces scabies*) is almost negligible in extent and severity, presumably owing to the acidity of the soil. Silver scurf (*Spondylocladium atrovirens*) is also stated to be of little importance in Florida.

Notes are given on various pathological conditions of seed tubers; the value of certified seed; methods of seed disinfection; and the application and preparation of sprays and dusts.

BÖNING (K.). **Vorbeugende Massnahmen zur Verhinderung von Kartoffelfäulen.** [Precautionary measures for the prevention of Potato rots.]—*Deutsche Obst- und Gemüsebauzeit.*, lxx, *Sondernummer* 14 b, pp. 160–161, 1924.

The three chief types of the storage rots of potatoes are that caused by *Phytophthora infestans*, the *Fusarium* dry rot, and the bacterial wet rot. A list is given of the commercial varieties that are extremely susceptible to storage rots and of those that have good keeping qualities.

Nitrogenous fertilizers and lime are often stated to predispose the tubers to storage rots, while potassium and phosphates are said to have the opposite effect, but no accurate data are available in support of such statements.

Potatoes should be stored in a well-ventilated cellar, the temperature in which should neither exceed 6° to 8° C. nor be allowed to sink below 0°, since the tubers are exceedingly susceptible to frost. Strewing the floor with lime dust or peat mould may be recommended on a small scale, but the latter, at any rate, is too expensive for general use.

SHAPOVALOV (M.) & LINK (G. K. K.). **Control of Potato tuber diseases.**—*U.S. Dept. of Agric. Farmers' Bull.* 1367, 37 pp., 39 figs., 1924.

The following diseases of potato tubers are described and figured, control measures being briefly indicated in each case. Blackleg (*Bacillus phytophthorus*) [*B. atrosepticus*]; slimy soft rot (*B. carotovorous*); late blight (*Phytophthora infestans*); *Fusarium* tuber rot (various types of which are distinguished); *Sclerotium* rot (*S. rolfsii*); leak (associated with *Pythium de Baryanum*, *P.* sp., *Rhizopus* sp., and *Mucor* sp., and producing liquefaction and granulation of the tissues, especially in the San Joaquin Valley of California and other warm, moist parts of the country); jelly end-rot, which attacks Burbanks in California and Netted Gems in Idaho, producing a gelatinous consistency in the succulent portions of the tuber (pointed ends and knobs), and frequently involving secondary attacks by *Fusarium* spp. and *Rhizoctonia solani*; vascular discolorations, due to various causes; *Fusarium* blight (*F. oxysporum* and possibly other species); *Verticillium* wilt (*V. albo-atrum*); bacterial wilt or brown rot (*Bacillus solanacearum*); scab [*Actinomyces scabies*]; powdery scab [*Spongospora subterranea*]; *Rhizoctonia* scab (*R. solani* and, to a slight extent, *R. crocorum*); silver scurf (*Spondylocladium atrovirens*); wart disease (*Synchytrium endobioticum*); and various physiological disturbances, including internal brown rot, net necrosis, black heart, and hollow heart.

The Bulletin further contains much valuable information on the various types of disease and their recognition; storage and transit conditions; and seed and soil treatments.

WÄHLING (G.). **Beizversuche mit Uspulun bei Kartoffeln.** [Disinfection experiments with uspulun on Potatoes.]—*Deutsche Obst- und Gemüsebauzeit.*, lxx, 16, p. 178, 1924.

The writer has obtained excellent results with uspulun, not only

in the control of club-root of cabbage [*Plasmodiophora brassicae*], but also in that of the most insidious potato diseases. Tubers placed in wide-meshed sacks and immersed in the solution according to directions, drained, and planted immediately, germinated a week earlier than the untreated controls, their foliage was brighter in colour and healthier, and their yield above the normal. These excellent results were observed when tubers affected with scab [*Actinomyces scabies*] were used, and appeared, in fact, to be entirely independent of the state of the seed. No trace of infection was detected in the progeny even of heavily scabbed tubers.

Esmarch (F.). **Zur Biologie des Kartoffelkrebses.** [The biology of Potato wart disease.]—*Deutsche landw. Presse*, li, 2, pp. 11–12, and 3, pp. 18–19, 1924.

The preliminary results of the author's laboratory experiments on the biology of wart disease of potatoes [*Synchytrium endobioticum*] are described. The principal objects of the investigations were to ascertain the method of emission of the zoospores from the resting sporangia, and also whether the zoospores are actively attracted by the host plant or merely conveyed to the latter in a passive state. It was shown (by means which are to be described elsewhere in detail and are therefore not indicated in the present article) that the evacuation of the resting sporangia is impeded by periodical drying: it may be concluded, therefore, that in wet seasons the conditions for wart disease are more favourable than in dry ones. Low temperatures (4° to 8° C.) and high temperatures (25°) retard, but do not inhibit, the emission of the spores, the optimum for the development of the fungus being estimated at 15° to 20°, i. e. the approximate temperature of the soil during the period of maximum incidence of the disease, July to September. Air is essential for the evacuation of the sporangia, which was almost entirely inhibited in an atmosphere of pure carbonic acid gas. Light had no effect on the discharge of the zoospores. Water drained off the roots of susceptible varieties of potatoes appeared to stimulate spore emission in some cases and not in others. Soil extracts from clay soil with a plentiful admixture of humus stimulated evacuation. This agrees with the well-founded observation that the disease occurs principally on such soils.

It was found that the percentage of empty sporangia was considerably higher in the spring and summer than in autumn and winter. The emission of the spores frequently occurs only after the lapse of weeks, or even months, under laboratory conditions. This is believed to point to the existence of important physiological factors which largely determine the period of evacuation.

The results of pot experiments to ascertain the method of infection by the swarm spores were inconclusive, but are regarded as indicating that the spores are carried passively to the plant by water or soil organisms, rather than actively attracted by some specific stimulus. It was observed that a period of four to six weeks sometimes elapsed between the penetration of the spores into the tuber and the appearance of external symptoms.

La Rue (C. D.). **Two unreported parasites of Hevea brasiliensis.** —*Papers Michigan Acad. Science, Arts and Letters,* pp. 69–71, 1923. [Received 1924.]

Two fungous parasites of the Pará rubber tree in the East are stated to have so far escaped discussion on account of the relatively slight damage which they cause.

A species of *Sclerotium*, resembling *S. rolfsii*, was found by the author in the exposed cells of the young extra-cambial bark of tapped trees in Sumatra. The mycelium of the fungus rapidly destroys bark tapped within two months of the time of attack, but bark tapped prior to this appears to be sufficiently protected by its corky layer to resist infection. Sclerotial formation occurs equally well in the field and under moist conditions in the laboratory.

Cephaleuros virescens is a common parasite of enfeebled rubber trees on the east coast of Sumatra, appearing on the twigs as a reddish-brown scurf which may extend over the greater part of the surface. The orange-yellow fruiting bodies of the alga are much more commonly found on twigs of several indigenous plants than on rubber. The organism occasionally attacks *Hevea* leaves, injuring and discolouring the mesophyll for a distance of 1 to 3 mm. from the point of infection. The appearance of the fruiting bodies on the surface, however, is often the only external indication of infection.

La Rue (C. D.) & Bartlett (H. H.). **A leaf-fall disease of Hevea brasiliensis Muell.-Arg. due to Gloeosporium albo-rubrum Petch.**—*Papers Michigan Acad. Science, Arts and Letters,* pp. 73–90, 1923. [Received 1924.]

In the early part of 1918 a severe leaf fall disease of rubber was observed over extensive areas on the east coast of Sumatra. Healthy and turgid new leaves began to fall off a few days after unfolding, to be replaced by a second and, if the dropping continued, by a third set. On severely affected trees the development of new leafy shoots from dormant buds, the ends of the current year's branches being left as bare spurs, finally resulted in a characteristic fastigiate branching. The trees were deprived of functional foliage for an abnormally long period, and this must have seriously impaired both their vigour and latex production. The disease was most prevalent on poor soils, where the trees were in a feeble condition. Meteorological factors, the exact nature of which has not yet been determined, are also believed to play an important part in the development of the disease.

A species of *Gloeosporium* closely conforming to the description of *G. albo-rubrum* Petch (probably identical with *G. heveae* Petch) was frequently isolated from the diseased Sumatran material, especially from petioles from which the leaflets had fallen. It was found to be associated with several abnormal conditions of the host, including leaf curl, leaf spot, yellow leaf, premature fall of young fruit, &c. Under normal plantation conditions the fungus is believed to exist in a dormant condition on many rubber trees. The leaf and fruit fall are apparently due to the growth of the mycelium from the older tissues to the new parts, while primary infection from spores is believed to cause the so-called tip and margin

disease. This type of infection may be produced by spraying the trees with a spore suspension of *Gloeosporium*, but the leaf fall and other symptoms attributable to the perennial mycelium in the host have not been artificially reproduced owing to the shortage of indubitably healthy material.

The inoculation of *Hevea* cuttings in damp chambers with *Gloeosporium* spores produces severe decay of all the young tissues. Similar results are obtained, after a much longer incubation period, in uninoculated cuttings containing dormant mycelium of the fungus.

The complex of diseases associated with *G. albo-rubrum* should be controllable by cultural measures tending to maintain the trees in a high state of vigour.

La Rue (C. D.) & Bartlett (H. H.). **Diplodia disease of Hevea brasiliensis.**—*Papers Michigan Acad. Science, Arts and Letters*, pp. 91–107, 1923. [Received 1924.]

During 1918 and 1919 cultures of *Diplodia cacaoicola* [*Botryodiplodia theobromae*], the cause of die-back of rubber, were obtained from practically all parts of *Hevea* trees on the east coast of Sumatra. The same organism is believed to be responsible for a storage rot of manihot tubers, and is actively parasitic on many other plants, especially the potato, in which it produces a rapid and destructive wet rot of the tubers.

The fungus, which grows particularly well on rice agar, was shown by experiments to be extremely pathogenic to *Hevea* seeds, and is believed to be responsible for their rapid deterioration under east Sumatran conditions. A condition of 'mouldy rot' of the tapping surface, which the author has found to be associated with *Diplodia*, but also with *Fusarium* (three forms), *Gloeosporium albo-rubrum*, *Helminthosporium heveae*, *Penicillium* sp., and various unidentified organisms, was also experimentally produced by inoculating with the *Diplodia* spores.

In wound inoculations reaching the wood, the mycelium of *D. cacaoicola* follows the vessels of the wood upwards and downwards from the point of inoculation and forms black streaks; inoculation of the tapping surface also causes black streaks in the underlying wood, and on renewed tapping these marks are indistinguishable from those known as black thread and usually attributed to *Phytophthora faberi*. The latter was entirely absent from the numerous trees unmistakably attacked by *Diplodia*. It appears reasonable, therefore, to conclude that the latter is primarily responsible both for mouldy rot and black thread, as they occur in the area in question.

The fungus causes little damage to healthy trees, but its effects may be serious in those grown under adverse conditions or subject to excessive wounding.

Van Overeem (C.). **Over het optreden van zwarte wortelschimmel (Rosellinia) bij Rubber en Koffie.** [The occurrence of black root disease (*Rosellinia*) on Rubber and Coffee.]—*Arch. Rubbercult. Nederl.-Indië*, viii, 3, pp. 135–137, 1 pl., 1924. [English summary.]

The black root disease was found to be attacking coffee on

a mixed coffee and rubber estate in Kediri, and a single case of the same fungus (*Rosellinia*) was also recorded for the first time on rubber.

The fungus formed on the roots of the trees fine, black, slightly flattened strands, which in some places were profusely ramified into the network characteristic of *Rosellinia*. The species concerned is stated to be probably *R. bunodes*, though perithecia were not found.

The use of the name 'black rot' is recommended for this rubber disease, as well as for that caused by the same fungus on tea and coffee; on the other hand it is not strictly applicable to the symptoms produced by *Sphaerostilbe repens* and should be discontinued in this connexion.

STEINMANN (A.). **Enkele mededeelingen over twee in Java tot nu toe minder bekende wortelschimmels bij Hevea brasiliensis.** [Notes on two root fungi of *Hevea brasiliensis* hitherto little known in Java.]—*Arch. Rubbercult. Nederl.-Indië*, viii, 3, pp. 138–140, 1924. [English summary.]

In connexion with the *Rosellinia* disease of rubber [see preceding abstract], a case is reported in which *Hevea* trees, planted on old coffee land in West Java, were attacked by the same fungus. The roots of 'lamtoro' (*Leucaena glauca*) plants remaining, together with a few old coffee stumps, from the former crop, proved to be the medium through which the infection spread to the newly planted rubber.

The fungus possesses two very typical features. In the early stages it forms slender, somewhat flattened strands of a dull black colour (deep black when moistened), ramifying on the surface of the bark; when more advanced the hyphae unite to form black incrustations of varying sizes.

On the coffee roots minute black spots and short hyphae in the wood can be readily detected, while in transverse sections black lines running radially through the wood and especially affecting the medullary rays were observed. According to Petch these symptoms are characteristic of *R. bunodes*, but owing to the absence of fructifications the identity of the fungus could not be definitely established.

Preventive measures should consist in the removal of old coffee stumps; the use of herbaceous, rather than woody legumes for green manure; and, in severe attacks, the isolation of affected groups of trees by trenches 2 ft. in depth.

Sphaerostilbe repens, hitherto unknown in Java, was also observed on the same estate where a few trees showed a yellowish discoloration and drooping foliage. The roots exhibited the brownish-red and crimson to black, flattened mycelial strands of *S. repens*, situated chiefly in the cortex beneath the external cork layer but also between the wood and the bark. The conidial stage of the fungus, consisting of erect, hirsute, red stalks, 2 to 5 mm. in length, with a pale pink or white globular head, was found near the root collar.

The fungus, which is generally regarded as primarily saprophytic in swampy ground, was evidently parasitic in the present case, the

affected roots still being healthy at the base. This is in accordance with Petch's statement that *S. repens* is sometimes responsible for the death of young trees on normal soil.

STEINMANN (A.). **Over eene ziekte van op de kweekbedden staande Heveazaailingen.** [A disease of *Hevea* seedlings in the seed-bed.]—*Arch. Rubbercult. Nederl.-Indië*, vii, 10, pp. 444-445, 1 pl., 1923. [English summary.]

A disease of *Hevea* rubber seedlings formerly incorrectly attributed to *Pestalozzia palmarum* is common in West Java during the dry season.

The chief symptoms are a partial defoliation of plants 25 to 35 cm. in height, and an annular, discoloured zone 1 to 2 cm. wide some distance from the collar, sometimes preceded by longitudinal fissures in the bark. The disease is rarely fatal, new roots generally being formed above the discoloured zone. Sometimes the stem dies off above the latter point, new shoots being formed which also become affected.

Such organisms as have been found in the discoloured area proved to be saprophytic and the disease has been ascribed to the abnormal heating of the soil by the sun's rays. It may be controlled by suitable shading or by covering the ground with straw.

STEINMANN (A.). **Over een heksenbezem bij Hevea brasiliensis.** [A witches' broom on *Hevea brasiliensis.*]—*Arch. Rubbercult. Nederl.-Indië*, viii, 3, pp. 130-134, 1 pl., 3 figs., 1924. [English summary.]

Young *Hevea* rubber trees in a West Java plantation were found to bear, at the tips of the branches, globose, woody bodies about the size of an apple and with a rugose surface. Externally these bodies, which were composed of numerous undeveloped buds closely crowded together, resembled cauliflowers. This is believed to be the first record of a malformation of this type on rubber.

It was evident from the general manner of growth that the malformations were due to a gall or witches' broom, one of the principal characteristics of which is the slight degree of differentiation of the tissues. This was very marked in the present case. A longitudinal section through one of the galls showed that it was composed mainly of pith, the cell walls being much swollen and pitted. Sclerenchymatous cells were also present in the pith. The development of the cortical and woody tissues was approximately normal, except that parenchymatous elements predominated in the wood, while there was an additional row of oblong sclerenchymatous cells below the sclerenchyma layer at the inner edge of the cambium.

The gall was fairly old when examined and was inhabited by various insects, all of which, however, were definitely found to be only secondary. Closer inspection revealed the presence in an intracellular position of a living fungous mycelium, which occurred primarily in the pith and in isolated cells of the wood, and was apparently absent from the bark. The hyphae were thick, septate, and filled with a dark brown, granular substance. Owing to the

absence of fructifications the fungus could not be identified, but it is hoped that when fresh material is available the position of the organism responsible for this rare disease of rubber may be established.

WAKSMAN (S. A.). **Influence of soil reaction upon the distribution of filamentous fungi in the soil.**—*Ecology*, v, 1, pp. 54–59, 1924.

The results of a series of experiments carried out in 1921 and 1922 on ten plots, $\frac{1}{20}$th of an acre in size and kept for the last 14 years under a definite system of fertilization, showed that the latter exerts a well-marked influence on the numbers of fungi in the soil, which was estimated by the author's method described in an earlier paper [see this *Review*, ii, p. 253]. It was found that fertilizers inducing an acid reaction in the soil tend to increase the number of fungi, and those creating alkalinity to decrease it. The plot which received annual applications of minerals (640 lb. acid phosphate and 320 lb. muriate of potash per acre) + $(NH_4)_2SO_4$ equivalent to 320 lb. $NaNO_3$, and had a very acid soil reaction (P_H 4·4 to 4·6), contained the highest number of fungi per gm. of soil (91,500). The smallest number of fungi among the unlimed plots occurred in one receiving minerals + $NaNO_3$ and having a reaction of P_H 5·6 to 5·8 (29,720 per gm.). Liming of the soil was found invariably to produce a decrease in the number of fungi, which averaged only 10,000 per gm. in a plot receiving minerals + 32 tons horse manure and lime (P_H 6·4 to 6·7).

The same change in reaction which led to a diminution of the numbers of fungi in the soil produced also an absolute and relative increase in the number of Actinomycetes and augmented the nitrifying and nitrogen-fixing capacity of the soil.

LYON (H. L.). **Cane pathology.**—*Rept. Comm. in charge of Exper. Stat. for year ending Sept. 30, 1923, Hawaiian Sugar Planters' Assoc.*, pp. 18–22, 1923. [Received 1924.]

The author records the occurrence in various parts of the Hawaiian islands of well-defined cases of root rot in Yellow Caledonia, Yellow Tip, D 1135, and H 109 canes [see next abstract].

A list is given of cultivated and wild grasses harbouring the virus of mosaic. The maize aphids [*Aphis maidis*], which according to Kunkel and other investigators are almost entirely responsible for the spread of mosaic of the sugar-cane in the field and which do not breed on the cane, have been observed on *Eleusine indica* and *Syntherisma pruriens*, two common weeds in the Hawaiian sugar-cane fields; there are reasons to believe that these grasses also harbour the mosaic virus.

Early in November 1922 eye-spot [*Cercospora sacchari* ? = *Helminthosporium sacchari*] made its appearance on H 109 canes in protected areas in Oahu and spread considerably during the two following months; by February 1923 it was rather severe on certain small areas, but the weather during the months immediately following was unfavourable for the rapid spread of the disease, and no serious damage was done to the canes.

The leaf disease of the Tip canes, which was described for the

first time in the Committee's report for the preceding year, continued to spread in the Kohala district, but apparently has not yet appeared outside it. So far, it has limited its attacks to the Tip canes and to one seedling, Kohala 56. A brief description is given of the disease, which is caused by parasitic bacteria; its virulence depends, to a large extent, upon weather conditions, and there seems to be little hope of controlling the trouble by any means but the use of resistant varieties.

An apparently new disease appeared in February 1923 in the seedling cane H 463 in Kauai, caused by an undetermined fungus which the author, on the ground of inoculation experiments, considers to be but a weak parasite and to have been able to attack the cane after the latter's vitality had been lowered by some other cause; another plausible explanation is that H 463 has a weak constitution.

The name of 'sectional chlorosis' has been applied to a curious banding of the cane leaves which appears simultaneously on the shoots over considerable areas. The injury, which always appears on three or four consecutive leaves, is in the shape of a white band one to four inches broad extending across the leaf. It evidently arises while the leaves are still rolled up in the spindle, and the cause apparently operates for a short time only and simultaneously on all the canes in a given area, as the injured shoots show but one series of bands and the latter occupy relatively the same position on the shoots. In some cases the tissues within the discoloured bands are killed, rendering the portion of the leaf above them useless; in the majority of cases, however, the banded leaves function normally in all portions except the discoloured areas. No satisfactory explanation of the trouble has yet been found.

Some apprehension has been aroused on the Hamakua coast of Hawaii by the appearance in canes of Yellow Caledonia of symptoms suggesting serious internal disorder. On splitting apparently healthy canes the greater part of the central tissues in each internode shows a white and pithy appearance, while in more advanced cases the tissues are brown in places and fissures of considerable size may be present. The trouble is not of parasitic origin and is not an uncommon occurrence in over-ripe Caledonia cane.

Lyon (H. L.). **The root-rot problem up to date.**—*Hawaiian Planters' Record*, xxvi, 4, pp. 259–266, 1923.

The author briefly reviews the work of different pathologists in Java and the West Indies in the endeavour to determine the primary cause of root rot of sugar-cane. In Java the 'root stalk' disease described by Wakker in 1895 was attributed to *Marasmius sacchari*, and the author accepts the evidence that this fungus is a parasite on cane roots and underground stems. A distinct root rot, however, is recognized in Java, which is not due to *Marasmius*, and the opinion predominates that this disease is due to temporary or prolonged deficiency in root aeration, usually caused by a more or less prolonged stagnation of water in the soil [see this *Review*, ii, p. 526]. In the West Indies the view is held that root disease is primarily caused by parasitic fungi, of which species of

Rhizoctonia are the principal. In Hawaii the disease closely resembles the root rot of Java.

A thorough study conducted by Larsen and Lyon both in the field and in the laboratory served to demonstrate that the fungi at first suspected, such as *Marasmius* and *Ithyphallus*, could not materially check the growth of the sugar-cane if the soil conditions were right, and supplied evidence that the real cause of root rot is some non-parasitic factor, probably a poison, present in the soil. Further studies by the Experiment Station showed that black alkali, to which the first clues pointed, was not the toxic ingredient in the soil responsible for the disease. Interest in root rot then waned in Hawaii, as seedling canes resistant to the disease were being rapidly introduced with satisfactory results, until 1919, when an aggravated form of the trouble appeared in the seedling cane H 146. The affected plants were growing in a well-drained, virgin soil and were irrigated with mountain water. Examination of living roots revealed the presence in them of a strictly parasitic Chytridiaceous fungus, which was also found in the roots of diseased Lahaina cane growing under similar conditions. It was suspected that this minute parasite might be the true cause of root disease and have escaped notice in other countries, but a search for it in other fields where root rot was highly prevalent failed, and the final conclusion was arrived at that it was present only under certain conditions. Shortly after Carpenter identified the cause of root disease in Hawaii as a *Pythium* and proved by cultural and inoculation experiments that it could act as a parasite attacking the living roots of sugar-cane, thus seriously retarding the growth of the latter. The fungus did not, however, cause the entire collapse of the plants in his experiments, even after their vigour was reduced through confinement in pots; besides it is of general occurrence in the soil throughout the cane fields in Hawaii and is not limited to the areas in which root rot occurs. The author believes that this fungus, like all others implicated, plays but a secondary part in the inception of root rot.

The Experiment Station is now engaged in determining the possible toxicity to sugar-cane of soluble aluminium compounds in the soil, an investigation which was suggested by Hoffer and Carr's work on root rot of maize [see this *Review*, iii, p. 32].

It is pointed out that a temporary solution of the root-rot problem has been arrived at in Hawaii by the use of resistant or tolerant varieties of sugar-cane. If the disease is due to parasitic organisms, it may be reasonably expected that these varieties will remain resistant, and the problem will thus be permanently solved; but if the disease is due to a non-parasitic factor in the soil, then resistance may eventually break down, and it is significant that in the last two years well-defined cases of root rot have occurred in several of the resistant varieties which saved the industry in Hawaii when the Lahaina cane failed.

STEWART (G. R.). **Root-rot investigation.**—*Rept. Comm. in charge of Exper. Stat. for year ending Sept. 30, 1923, Hawaiian Sugar Planters' Assoc.*, pp. 44–46, 1923. [Received 1924.]

An extensive investigation has been started at the Experiment

Station of the chemical factors influencing the development of root rot of the sugar-cane. The preliminary plan of work comprises the study of nutrients, root-respiration, and soil oxidation. The investigation will be made in close co-operation with plant pathologists.

AGEE (H. P.). **Resistance to disease and adverse conditions by hardy Sugar cane types.**—*Rept. Comm. in charge of Exper. Stat. for year ending Sept. 30, 1923, Hawaiian Sugar Planters' Assoc.*, pp. 58–62, 1923. [Received 1924.]

The Experiment Station has imported from Washington four hardy varieties of Java canes which had developed no unforeseen troubles during the year's quarantine in Washington; as a further measure of safety, the cuttings were planted in a quarantine house in Hawaii, and if the plants thus grown prove satisfactory, cuttings from them will be released for planting in the open late in 1924.

FAWCETT (G. L.). **La disinfección de la Caña por la calefacción.** [Disinfection of Sugar-cane by heating.]—*Rev. Indust. y Agric. de Tucumán,* xiii, 11–12, pp. 205–206, 1923.

The most important diseases of sugar-cane which are transmitted through the seed-piece are gummosis, sereh, and mosaic. Of these only the last is present in the Province of Tucumán, Argentine Republic. After referring to Miss Wilbrink's work on the subject [see this *Review*, ii, p. 468] the author describes his own experiments in the control of mosaic by steeping the seed-pieces in water heated to temperatures varying between 48° and 58° C. The results were negative in all cases, the seed-piece being killed at about 50° C., while at lower temperatures plants grown from treated seed invariably developed the disease. Tests with X-rays were also unsuccessful, though it is thought possible that further experiments with longer exposures may be more satisfactory. The author is of opinion that insects inside the seed-pieces could easily be destroyed by the hot-water treatment; on the whole, however, the treatment, under conditions current in Tucumán, is regarded as of no practical importance.

FAWCETT (G. L.). **El mosaico de la Caña de Azucar.** [Mosaic of Sugar-cane.]—*Rev. Indust. y Agric. de Tucumán,* xiv, 1–2, pp. 6–8, 1 fig., 1923. [Received 1924.]

This is a reprint of a circular (No. 10) issued by the Agricultural Experiment Station of Tucumán, Argentine Republic, and contains a *résumé* of the present state of knowledge concerning mosaic of sugar-cane and its control.

The symptoms of the disease, its effects on the yield of affected canes, and the value of immune and resistant varieties, are discussed. Kavangire, Uba, Yon Tan San, and other Japanese varieties, as well as Kassoer, and probably T.J.E.P. 24 and 2714 P.O.J., are immune, while 2725 P.O.J. is given as resistant. The effects of the trouble vary greatly with the varieties. While the cultivation of many of the imported and of the indigenous canes has had to be abandoned owing to the low yield brought

about by mosaic, others, such as P.O.J. 213, 36, 826, 979, 2379, and 1228, do not appear to suffer to any great extent in this respect and are still profitably cultivated in Tucumán.

The author, in referring to insect transmission, states that several grasses, i.e. Rhodes [*Chloris gayana*], Bermuda [*Cynodon dactylon*], and elephant (*Pennisetum purpureum*) are wholly or partly immune and can be planted near sugar-cane with impunity. The usual methods are recommended for the eradication of the disease, but the growing of immune varieties like Kavangire presents serious difficulties, since they do not possess the qualities which make the cultivation of the susceptible indigenous canes so attractive. The author thinks, however, that if Kavangire had been generally adopted some years ago the disease would have been stamped out by now, and the more profitable varieties could have been replanted without fear of infection.

GUBA (E. F.) & YOUNG (P. A.). **Check list of important references dealing with the taxonomy of fungi.**—*Trans. Amer. Micro. Soc.*, xliii, 1, pp. 17–67, 1924.

This publication gives a classified list of the chief general works, monographs, and special papers on the classification and description of fungi, especially those published since 1900.

BUCHHEIM (A.). **Uromyces pisi (Pers.) Winter.**—*Centralbl. für Bakt.*, Ab. 2, lx, 22–24, pp. 534–536, 1924.

The results of further inoculation experiments with aecidio- and uredospores of *Uromyces pisi* [see this *Review*, ii, p. 341], carried out in the summer of 1922 at Moscow, were as follows. Aecidiospores from *Euphorbia esula* were found capable of infecting *Lathyrus nissolia*, *L. articulatus*, *L. sativus* var. *coeruleus*, *L. aphaca* var. *typicus*, *L. heterophyllus*, *L. odoratus*, and *L. vernus*.

Uredospores of *U. pisi* on *L. pratensis* infected *L. sylvestris*, *L. articulatus*, *L. gorgoni*, *L. sativus* var. *albus*, *L. aphaca* var. *typicus*, *L. cicera* f. *genuinus*, *Orobus luteus*, and *O. vernus*.

Several of these hosts are not mentioned by Sydow (Monographia Uredinearum, ii, 1910).

PETRI (L.). **Sur la formation des chlamydospores chez l'Oïdium des Chênes.** [On the formation of chlamydospores in the *Oidium* of the Oak.]—*Congrès Path. vég.* (*Centenaire de Pasteur*), *Strasbourg, 1923*, pp. 36–37, 1923.

The author succeeded in infecting healthy young oak leaves with *Microsphaera quercina* by placing on them pieces of dead leaves from the previous season bearing spots of mildew in which all the hyphae and conidia of the fungus were dead and which bore no perithecia. Microscopical examination showed the constant presence on the old spots of bodies which the author considers to be reduced chlamydospores. These were hyaline, sphaeroidal cells, 24 to 32 μ in diameter, and with a thick, smooth or slightly wrinkled membrane in three layers. In water the external layer bursts and emits the inner layers surrounding a central mass of cytoplasm and yellowish granules. They are considered to be a further development of the spherical swellings observed by Ferraris on

the hyphae of this species and afterwards by Foëx on several other Erysiphaceae.

FOËX (E.). **Quelques mots sur les modes d'hibernation des Erysiphacées.** [A few words on the mode of overwintering of the Erysiphaceae.]—*Congrès Path. vég.* (*Centenaire de Pasteur*), *Strasbourg, 1923*, pp. 37–41, 1923.

In this note the author briefly reviews his own work and that of others on the overwintering of the Erysiphaceae. In support of the view that some species may tide over the winter in dormant buds he cites Chabrolin's observations of two young apple trees which in 1922 had been attacked by *Podosphaera leucotricha*; in the spring of 1923 six buds on the two trees were already white with mildew on opening, and it was noted that the disease spread from the base of the petiole towards the apex of the leaf blade; this would suggest that the fungus had overwintered in a still unknown form under the leaf scales in the buds. Petri's discovery of chlamydospores [see last abstract] in the case of *Microsphaera quercina* is regarded as confirming Ferraris's hypothesis of the part played in the perpetuation of the fungus by the thickenings of the hyphae found by the author and others in the old mycelium on dead leaves of oak and various other plants, and on the twigs of the vine.

PEYRONEL (B.). **Sopra un singolare parassita polifago: Valdensia heterodoxa n. gen. et n. sp.** [On a singular polyphagous parasite: *Valdensia heterodoxa* n. gen. et n. sp.]—*Staz. Sperim. Agrar. Italiane*, lvi, 10–12, pp. 521–538, 15 figs., 1923. [Received 1924.]

For some years past the author has noticed a disease—often of an epidemic character—of the bilberry (*Vaccinium myrtillus*), growing in the Valdensian valleys in Italy. The cause is a fungus previously undescribed, which is named *Valdensia heterodoxa* n. gen. et n. sp. Besides the bilberry it attacks a large number of other plants belonging to ten families, a list of which is given.

The chief symptom is the appearance of roundish, withered spots on the leaves, generally surrounded by a brown or reddish halo, the intensity of the coloration depending directly on the amount of sunlight to which the leaves are exposed. The anthocyanin pigments produced on infected leaves exposed to light are thought to play a part in aiding the leaf tissue to resist the action of the fungus, the spots being smaller in such cases than in shaded plants.

The hyphae penetrate through the cuticle of both surfaces of the leaf and are very large (up to 14 μ in thickness) within the tissues. Large, roundish cells, surrounded by a loose network of hyphae, develop under the epidermis, and from these the organs of propagation arise. Each round cell puts out a short protrusion which penetrates the epidermis (often through the stomata) and swells into a second cell from which four radiating arms arise. These become septate, up to 13 or 14 cells being formed in each arm. The lower cells put out semicircular folds or swellings on the under (outer) side and, from these, two outgrowths bend round the stem

towards the upper (inner) side. In the centre, between the arms, the external swollen cell becomes covered with a mass of small protuberances covered with mucus.

These curious organs, which may be up to ½ mm. in diameter, are regarded as bulbils rather than spores. When ripe they become detached from the subepidermal mother cell and are blown on to other leaves to which they adhere by the mucus covering the central part. Germination can take place from any cell.

SCHERFFIUS (W. H.). **Tobacco mosaic. Some interesting experiments on a supposed disease in Turkish Tobacco.**—*Journ. Dept. Agric. S. Africa*, viii, 1, pp. 33–34, 2 col. pl., 1924.

Experiments carried out in the Western Cape Province to ascertain the cause of the green splotches in the cured leaves of Turkish tobacco affected with mosaic, and of the lifeless condition of the dried leaves, would seem to have proved that mosaic is not primarily responsible, though it may be a secondary cause. The trouble has been shown to be due to harvesting the tobacco in the heat of the day with gummy hands and bruising the leaves in the operation, and no after-treatment was effective in removing the green splotches. Blistering by the sun, and too rapid drying, will produce the same results.

Harvesting should be done only in the cool of the day, and the leaves must be kept cool while they are being strung.

HANSFORD (C. G.). **Tomato diseases and their control.**—*Jamaica Dept. of Agric. Microbiol. Circ. 3 of 1923*, 12 pp., 1924.

The symptoms and control of the various fungous diseases of tomatoes in Jamaica are briefly described.

Damping-off, associated with *Rhizoctonia*, *Fusarium*, and *Pythium*, occurs in the seed-beds.

Leaf rust or mould (*Cladosporium fulvum*) is apt to cause serious damage in Jamaica at all times of the year. In the lower part of the island it usually appears a few days after a short period of cool, showery weather. Infection seems to persist from one season to another, either on tomato plants or in the soil. Under Jamaican conditions, plants once attacked by the disease set very little fruit, and unless prompt action is taken on the first sign of infection there is little chance of saving them. The disease may be controlled by the application of Bordeaux mixture 4–4–50.

Leaf spot (*Septoria lycopersici*) gives considerable trouble in the island and can only be controlled by careful and systematic spraying with Bordeaux mixture (3–4–50 for seedlings and 4–5–50 for older plants).

Wilt (*Fusarium lycopersici*) and bacterial wilt (*Bacterium solanacearum*) are both found, the former not to any great extent. Late blight (*Phytophthora infestans*) also is not very serious under Jamaican conditions, occurring only in cool weather, and being readily controllable by spraying with Bordeaux mixture 5–5–50.

Blossom-end rot of the fruit, due to an unknown cause, is probably the result of attacks by a group of different organisms. Secondary invasions by *Fusarium solani* and *Macrosporium*

solani have been observed in connexion with the disturbance. Abundant irrigation of the roots while keeping the foliage as dry as possible is recommended. Anthracnose or ripe rot (*Colletotrichum phomoides*) is also found, while brown rot (*Rhizoctonia*) is probably, though not certainly, present.

WILLIAMSON (Mrs. H. S.). **The origin of 'golden' Oak.**—*Ann. of Botany*, xxxvii, 147, pp. 433–444, 1 pl., 4 figs., 1923.

From a specimen of seasoned heartwood of oak (*Quercus robur*) which showed a yellow coloration to a depth of two or three millimetres, three fungi were isolated: a species of *Aspergillus*, *Penicillium luteum*, and *Eidamia catenulata* [see this *Review*, iii, p. 306]. The latter was also isolated from the interior of the wood, and on inoculation was found to produce the golden colour in healthy oak timber, so that it is regarded as responsible for the characteristic appearance of the wood. Inoculations on beech and chestnut wood caused the former to darken somewhat, while the latter showed a marked golden colour.

The morphological and physiological characters of the fungus are described. Conidia are frequently found in the vessels, either in yellow chains, or singly, when they are colourless. Both in the original specimen and in inoculated wood, hyphae were found with glistening yellow globules exuded on their surface. The reactions of these globules somewhat resembled those of 'wood-gum'. They accumulate in the cells and may ultimately fill them completely, the hyphae in such cases being often disorganized. The yellow substance is insoluble in acid or alkali, and the cell walls are not stained by it. The fungus does not appear to produce delignification or to attack the cell walls themselves, but a certain amount of splitting of the middle lamella was visible in sections of infected wood. Passage from cell to cell is exclusively through the pits.

E. catenulata can grow on poor media, a fact which enables it to subsist on the small quantities of nutriment available in seasoned wood. This consists chiefly of soluble pectic bodies, glucosides, and any gallic acid, starch, proteids, or organic salts that may occur.

LEHMANN (K. B.) & SCHEIBLE (E.). **Quantitative Untersuchung über Holzzerstörung durch Pilze.** [Quantitative investigation of wood destruction by fungi.]—*Arch. für Hygiene*, xcii, 2–3–4, pp. 39–108, 1923.

The investigations conducted at Würzburg [Bavaria] during 1920–1921 on the action of various fungi on coniferous and deciduous wood are described in considerable detail. Cultures were obtained of *Merulius lacrymans*, *Polyporus vaporarius*, *P. destructor*, *Daedalea quercina*, *Coniophora cerebella*, *Stereum purpureum*, *Armillaria mellea*, and an undetermined but very destructive species resembling *P. vaporarius*. It was found that the most complete utilization of sugar in beer wort cultures was effected by *A. mellea* (91·0 gm. in 3 months) and the least by *S. purpureum* (39·4 gm.). The order in which the fungi utilized sugar in the cultures approximately corresponds to that in which they destroy the cellulose of the wood in nature.

Tests were made of the activity of the fungi on wood as

expressed by the evolution of carbonic acid and the decrease in weight of the inoculated wood. With *P. vaporarius* on *Pinus laricio* there was a marked increase in the evolution of carbonic acid from the 14th day onwards (up to over 134 mg. per kg. per hour). The corresponding loss of cellulose was estimated at 1·979 gm. per kg. wood per diem. With *C. cerebella* on birch the formation of CO_2 amounted to 227·5 mg. per kg. per hour, corresponding to a loss of cellulose of 3·351 gm. per kg. per diem. In both these cases the optimum temperature for the action of the fungus was about 26° C.

The loss of specific weight of birch wood, stored in a cellar and inoculated with *C. cerebella*, was estimated at 13 per cent. in 8 months. In another test the loss of specific weight after 8 months amounted to 13·6 per cent. in birch wood inoculated with *C. cerebella* and to 20·4 per cent. in pine wood inoculated with *P. destructor*. Inoculation with *C. cerebella* was found to promote the development of *S. purpureum* on the same substratum.

The optimum water-content of the wood for fungous development was also investigated and determined as follows: *M. lacrymans* 20 per cent.; *P. vaporarius* and *P. destructor* 35 per cent.; the undetermined species resembling *P. vaporarius* 35 to 40 per cent.; *D. quercina* about 40 per cent.; *A. mellea* 45 per cent.; *S. purpureum* 45 to 50 per cent.; and *C. cerebella* 50 to 60 per cent. The percentage loss of substance in birch and fir wood with the optimum water-content, as defined above, was determined to be as follows, each flask being given a 2 months' preliminary inoculation with *C. cerebella*, followed by 4 months with each of the other species. (A) Birch: (1) *M. lacrymans* 20·4; (2) *P. vaporarius* 4·1; (3) *D. quercina* 5·3; (4) *C. cerebella* 9·9; (5) *S. purpureum* 4·8; (6) *P. destructor* 11·7; (7) undetermined species 13·1. (B) Fir: (1) 18·3; (2) 10·1; (3) 3·8; (4) 9·8; (5) 4·2; (6) 11·4; (7) 12·7. In a series of comparative tests, in which the preliminary inoculation with *C. cerebella* was omitted, the work of destruction proceeded much less rapidly. The results obtained with *A. mellea* are omitted on account of contaminations.

The actual percentage loss of calorific value [the technique of methods for the determination of which is fully described] in 6 months was estimated as follows: *A. mellea* 42·9; *M. lacrymans* 35; undetermined species 34·1; *P. vaporarius* 30; *P. destructor* 28·9; *C. cerebella* 17·7; *S. purpureum* 10·3; *D. quercina* 8·1.

It would appear from these experiments that the extent and severity of the damage caused by these fungi under Central European conditions are far greater than is generally assumed.

FRITZ (CLARA W.). **Cultural criteria for the distinction of wood-destroying fungi.**—*Proc. and Trans. Roy. Soc. Canada, Third Series*, xvii, Sect. v, pp. 191–284, 12 pl. (4 col.), 1923. [Received 1924.]

With a view to testing and supplementing the field methods used in the identification of organisms responsible for heartwood and sapwood rots in Canadian forests, an attempt was made to elaborate a system of laboratory cultural diagnoses. The fungi used in the experiments were *Fomes applanatus*, *F. fomentarius*, *F. igniarius*,

F. pinicola, *F. roseus*, *Polyporus borealis*, *P. schweinitzii*, *P. sulphureus*, *Polystictus abietinus*, *P. versicolor*, and *Trametes pini*, a detailed description of each of which is given, together with a tabulated account of their characters of growth on potato-dextrose, malt, Czapek's synthetic (modified) agars, and other less satisfactory media. Growth on the first of these proved to be, on the whole, the most satisfactory, and it was used as a basis for the differentiation of the forms studied.

Parallel cultures were started from actively growing mycelium and subjected to standardized conditions as regards nutrition, light, and temperature. The fungi studied were cultured from as many different sources as possible, but in most cases only a slight range of variations was noted in the characteristics displayed by each of the different organisms whatever its source. One distinct strain of *F. igniarius*, from sporophores on poplar trees, was, however, obtained.

The prevalent rots of balsam (*Abies balsamea*) are classified in three groups, the gross characters of which are figured and described in detail. The first group (rot type A) includes the rot caused by *Polyporus balsameus* and by an unidentified species. Rot type B included *Poria subacida* and two unidentified species, and rot type C was due to an unidentified species. The morphological and cultural characters of each of these fungi are described. The unidentified forms were not associated with sporophores.

A bibliography of 57 titles is appended.

SCHMITZ (H. W.). **Studies in wood decay. IV. The effect of sodium carbonate, bicarbonate, sulphate, and chlorid on the rate of decay of Douglas Fir sawdust induced by Lenzites saepiaria Fr., with special reference to the effect of alkaline soils on the rate of decay of wood in contact with them.**—*Amer. Journ. of Botany*, xi, 2, pp. 108–121, 5 graphs, 1924.

In order to determine the effect of the constituents of alkaline soils on the rate of decay of Douglas fir (*Pseudotsuga taxifolia*), 5 gm. of fine, air-dried sawdust were placed in 125 c.c. Pyrex extraction flasks, to which 25 c.c. of solutions of sodium carbonate, sodium bicarbonate, sodium chloride, or sodium sulphate were added in duplicate, several different strengths of solution being used. The culture flasks were then plugged with cotton and sterilized for 20 minutes at 10 lb. pressure. After cooling they were inoculated with *Lenzites saepiaria* and incubated at 28° for 120 days.

The presence of small amounts of sodium carbonate or bicarbonate appears, from the results of these experiments [details of which are given], to increase the rate of decay by *L. saepiaria*, this effect being augmented still further by the presence of sodium sulphate. It is questionable whether sodium chloride acts in a similar manner. These conclusions are substantiated by the results of a preliminary series of experiments not discussed in the present paper.

No clear evidence is presented of an antagonistic action between the various anions under the particular conditions obtaining in the experiments.

In general, it appears safe to conclude that, in some cases at least, the average life of wood in contact with alkali soils of certain composition may be shorter than that of the same kind of wood in contact with ordinary soils.

MANGIN (L.). **Les champignons destructeurs du bois.** [Wood-destroying fungi.]—*Comptes Rendus Acad. d'Agric. de France*, x, 13, pp. 428–429, 1924.

The principal wood-destroying fungi of economic importance in France are stated to be *Paxillus acheruntius*, which occurs chiefly in mines, *Lenzites saepiaria*, *Coniophora cerebella*, *Trametes vaporaria*, *Merulius lacrymans*, and *Phellinus* [*Fomes*] *cryptarum*. The routine treatment of building timber with wood preservatives is advocated. Carbolineum, one or other of its derivatives, or microsol should be applied to the surfaces of all wood used for construction, thus preventing the egress of the fungus if already present in the timber, or its penetration from without if the material is still sound.

NANNIZZI (A.). **Una specie critica di 'Oidium' sulla 'Robinia hispida' L. (Oidium orbiculare Nannizzi = Oidium monosporum Pass.; Ovulariopsis monospora (Pass.) P. A. Sacc. e D. Sacc.)** [A critical species of '*Oidium*' on '*Robinia hispida*' L. (*Oidium orbiculare* Nannizzi = *Oidium monosporum* Pass.; *Ovulariopsis monospora* (Pass.) P. A. Sacc. & D. Sacc.]—*Riv. Patol. Veg.*, xiii, 7–8, pp. 121–127, 1923.

A fungus agreeing with *Ovulariopsis monospora*, except that the conidia were in chains, was found by the author on *Robinia hispida* at Siena in 1923.

Examination of Passerini's type specimen showed that spore chains are also present in the original material.

A revised Latin diagnosis of the fungus is given and the name changed to *Oidium orbiculare*, because Passerini's name *O. monosporum* does not correctly represent the characters of the fungus.

MARTIN (G. H.). **Diseases of forest and shade trees, ornamental and miscellaneous plants in the United States in 1922.**—*Plant Disease Bull. Supplement* 29, pp. 393–461, 1 map, 1923. [Received 1924.]

This summary has been compiled on the same general lines as those of previous years [see this *Review*, ii, p. 205].

Keithia thujina is stated to show signs of becoming very serious on *Thuja plicata* in Idaho. Balsam firs (*Abies balsamea*) were severely attacked in Pennsylvania by fir-fern rust (*Uredinopsis mirabilis*), which occurred on *Osmunda claytoniana* at least 8 miles from any known *Abies* plantations. Stringy brown rot (*Echinodontium tinctorium*) causes a most destructive decay of western hemlock (*Tsuga heterophylla*). Pitch pine (*Pinus rigida*) on Cape Cod (Massachusetts) was affected by a disease involving discoloration and dying-off of about half the distal portion of the needles. *Hypoderma desmazieri* was found associated with the trouble to a slight extent. White pine (*P. strobus*) suffered severely in New Hamp-

shire from a butt rot caused by *Fomes pinicola*. An account is given of the status of pine blister rust (*Cronartium ribicola*) control in Pennsylvania, to which a bibliography of recent literature on the disease is appended. Chestnut blight (*Endothia parasitica*) continued its steady spread southward and westward during 1922; the zone in which 80 per cent. of the trees are infected has now nearly reached North Carolina, and the disease is becoming prominent in north-western Pennsylvania. In the vicinity of New York quite a number of oriental chestnuts have escaped or recovered from the disease. White elms (*Ulmus americana*) were extensively attacked (up to 100 per cent.) by anthracnose (*Gnomonia ulmea*), which resulted in serious defoliation. Nut rots of hickory (*Hicoria* spp.), with which *Penicillium* sp., *Fusarium* sp., and an undetermined Phycomycete were associated, were reported from Indiana. Horse chestnuts (*Aesculus hippocastanum*) were very generally attacked by leaf blotch (*Guignardia aesculi*), which appears to be almost uniformly increasing in prevalence and severity.

Several of the other diseases of trees enumerated in the Report have already been noticed in this *Review*. Among other interesting records of diseases affecting ornamental plants may be mentioned stem rot and wilt of carnations, caused by a *Fusarium*, and mosaic of dahlias, fuchsias, and snapdragons (*Antirrhinum*).

GRAVATT (G. F.). **The spread of the Chestnut blight in the southern Appalachians.**—*Journ. Amer. Leather Chem. Assoc.*, xix, 3, pp. 138–146, 2 figs., 1 map, 1924.

Chestnut blight (*Endothia parasitica*), which has invaded about three-quarters of the commercial range of the chestnut since its introduction into the United States in 1904, is stated to be rapidly spreading in North and South Carolina. Advance infections have been found more than 150 miles ahead of the main diseased area near the Virginia–North Carolina border. It is estimated that the zone of heavy infection (80 per cent.) spread across Virginia in approximately 10 years, i.e. at the rate of 24 miles per annum. The spread westward and into the main Appalachians has been steady but much slower than in a southward direction.

As soon as trees attacked by *E. parasitica* are killed, or even before, wood-decaying fungi secure entrance through the dead portions of the bark, and the resulting sap rot begins to show a year or two later. Part of the heartwood also decays in some cases, while root and stump rot are prevalent in certain sections. The general deterioration loss due to blight is estimated at 10 to 40 per cent. of the value of the standing chestnut timber. In the southern Appalachians such losses are expected to involve over 30,000,000 acres with a general average of 50 per cent. chestnut.

It is stated to be the considered opinion of experts at the Bureau of Plant Industry that the present chestnut stand is doomed. Possibly the eradication of diseased individuals in isolated centres of infection may retard the death of the stands at some considerable distance from the main zone of the blight, but no results of permanent value can be expected from such measures. A more

promising line of control is the selection of resistant varieties, though many years must elapse before the ultimate value of the investigations now in progress in that direction can be definitely appraised.

DURAND (J. P.). **Le Trametes du Pin.** [The *Trametes* of the Pine.]—*Rev. Eaux et Forêts*, lxii, 2, pp. 59–61, 2 pl., 1924.

Throughout the region of Vancluse and Luberon [south of France] the Aleppo pine [*Pinus halepensis*] is stated to be subject to the attacks of *Trametes pini*, which forms one or more fructifications between the base and the crown. In the former case it may safely be assumed that the wood is infected from the base to a distance of 1 to 3 m. above the fructification; in the latter the entire trunk is diseased. Trees of all ages are affected, the incidence of the disease in certain localities amounting to 50 to 80 per cent. of the stand. *Pinus maritima*, which is susceptible to the fungus in other districts, appears to be immune in the region under discussion, as are also *Pinus sylvestris* and other conifers grown there.

Infection appears to result from the germination of the spores, under humid conditions, in cracks or wounds in the bark, the mycelium subsequently penetrating the wood through dead branches or wounds. Certain cells of the invaded region react by the production of large quantities of a dark-coloured, heavy, and very pungent resin. The wood thus impregnated is known commercially as 'oil wood', and is in considerable demand for firewood, fetching a wholesale price of 9 to 10 francs per 100 kg. Wood attacked by *T. pini* cannot, however, be used for the main purpose for which the pine is grown, namely, cabinet-making.

The spring wood succumbs to the attacks of the fungus before the autumn wood, and years may elapse between the first invasion of the tree and its ultimate collapse. The fungus dies with its host and is succeeded by *Fomes pinicola*, which rapidly produces the complete decomposition of the wood.

ANDERSON (M. L.). **Heart rot in Conifers.**—*Trans. Roy. Scot. Arbor. Soc.*, xxxviii, 1, pp. 37–45, 1924.

Notes are given regarding the occurrence of the heart rot of conifers caused by *Fomes annosus* in various parts of Britain. Even comparatively young trees (15 to 45 years of age) were observed to be severely attacked, and a serious feature of the disease is the fact that it may proceed for many years unnoticed, the damage being absolutely confined to the internal portions of the tree. It is probable that many apparently healthy plantations are suffering from heart rot in a more or less acute degree.

The disease was found in a severe form in middle-aged and mature stands of Norway spruce [*Picea excelsa*] and European larch [*Larix europaea*] in the north-east of Scotland, especially on dry, sandy soils and glacial deposits. Larches are also liable to severe damage from heart rot in Northumberland. An 18-year-old plantation of Douglas fir [*Pseudotsuga taxifolia*], usually regarded as practically immune from *F. annosus*, was severely attacked in Peeblesshire, the fructifications of the fungus being common.

Western red cedars (*Thuja gigantea*), 17 years old, showed the early stages of heart rot in Northumberland.

Japanese larches [*Larix leptolepis*] were affected in several localities, over 50 per cent. of the thinnings being infected in some cases. Scots pines [*Pinus sylvestris*] and *Abies grandis* are amongst other hosts of the fungus observed, the former being severely damaged in Lanark, where the soil is derived from a stiff, heavy, boulder till of the carboniferous series.

Control measures should be based on soil preparation, including the removal of old stumps of previous crops, and careful selection of species especially in regard to their soil requirements.

GILBERT (W. W.) & POPENOE (C. H.). **Diseases and insects of garden vegetables.**—*U.S. Dept. of Agric. Farmers' Bull.* 1371, 46 pp., 63 figs., 1924.

The following fungous and bacterial diseases are briefly described in popular language, with recommendations for appropriate treatment. Damping-off of tomato and other seedlings [*Pythium de Baryanum*]; bean mosaic, blight [*Bacterium phaseoli*], rust [*Uromyces appendiculatus*], and anthracnose [*Colletotrichum lindemuthianum*]; leaf spot of beets [*Cercospora beticola*]; club-root of cabbage and other Cruciferae [*Plasmodiophora brassicae*]; cabbage wilt [*Fusarium conglutinans*], black rot [*Bacterium campestre*], and blackleg [*Phoma lingam*]; leaf spots of celery [*Cercospora apii, Septoria apii*, and *Bacterium apii*]; cucurbit mosaic, downy mildew [*Pseudoperonospora cubensis*], angular leaf spot [*Bact. lacrymans*], wilt [*Bacillus tracheiphilus*], and leaf spot [*Cercospora cucurbitae*]; onion smut [*Urocystis cepulae*]; pod spot [*Ascochyta pisi*] and stem rot of peas; potato mosaic and other potato diseases; stem rot [*Fusarium batatatis* and *F. hyperoxysporum*] and black rot [*Sphaeronema fimbriatum*] of sweet potatoes; tomato wilt [*Fusarium lycopersici*], leaf spot [*Septoria lycopersici*], and blossom-end rot.

Directions are given for the preparation and application of various standard fungicides for the control of these diseases.

SWINGLE (W. T.), ROBINSON (J. R.), & MAY (E). **Quarantine procedure to safeguard the introduction of Citrus plants: a system of aseptic plant propagation.**—*U.S. Dept. of Agric. Circ.* 299, 15 pp., 9 figs., 4 diag., 1924.

The apparatus, equipment, and other mechanical features of the citrus quarantine greenhouse at Bethesda, near Washington, D.C., are briefly described.

In dealing with new introductions the writers have evolved a new system of plant propagation during the last few years, namely, that of regeneration through the double transfer of buds. The original plants are kept only until the new growth is suitable for propagation, when the buds (if the plants are found to be entirely free from any form of infection) are transferred, by budding or grafting, to new, vigorous, home-grown stocks, growing in the isolation ward of the quarantine greenhouse. When the buds are safely established, the original plants and any adhering soil are destroyed. When the newly budded plant has made sufficient growth,

a second transfer is made on new clean stocks, and if no disease has appeared in the meantime these last buds are admitted to the main section of the greenhouse. On release from the latter the plants are placed in a special screened compartment known as the 'detention cage' in one of the Washington greenhouses, subsequently repotted in freshly sterilized soil, admitted to the main propagating house, and declared eligible for field trial.

Particulars are given of the regulations for the disinfection of implements, workers' clothing, and the like, and of other precautions in connexion with the quarantine system.

Dorsey (M. J.). **Symposium on crown gall inspection.**—*Proc. Amer. Soc. Hort. Sci. 1923*, pp. 255–256, 1924.

The following is the substance of a report adopted by a committee on crown gall (*Bacterium tumefaciens*) inspection consisting of members of the above Society.

Owing to the wide distribution of *Bact. tumefaciens*, the large number of its hosts, and the difficulty of detecting all affected plants, official inspection of nursery stock for the purpose of preventing the dissemination of the organism is unwarranted. The sole object of crown gall inspection is to prevent the sale and planting of stock which will not produce a normal crop.

Owing to the variability of crown gall injury on different species of plants, and even on different varieties of the same species, and to the fluctuations of the disease with the character of the soil, methods of culture, and climatic conditions, it is impracticable to adapt uniform inspection regulations for all kinds of plants, or for all parts of the United States.

In each State the extent of the injury inflicted by crown gall on the principal economic plants grown in that particular locality should be accurately determined by plant pathologists, horticulturists, or other qualified persons, and the resulting data used as the basis of inspection regulations.

Crown gall injury, the injurious effects of which have generally been over-estimated, especially in the case of apples, is least pronounced in the northern and north-western portions of the United States.

The inspection regulations should describe fully and accurately the symptoms on which a rejection of the plants is to be based, and considerable tolerance should be allowed. Field inspection for crown gall is unreliable; examinations should be conducted at the packing-shed or at the point of destination. The rejection of an entire shipment on account of a slight incidence of crown gall is stated to be unjustifiable.

Wart disease.—*Scottish Journ. of Agric.*, vii, 1, pp. 72–82, 1 map, 1924.

In this paper the origin, present distribution, life-history, and control of wart disease of potatoes (*Synchytrium endobioticum*) are described, together with an account of the legislation in force in the various countries affected.

IMPERIAL BUREAU OF MYCOLOGY

REVIEW

OF

APPLIED MYCOLOGY

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Baxter (D. V.). **The heart rot of Black Ash caused by Polyporus hispidus Fr.**—*Papers Michigan Acad. Science, Arts and Letters*, iii, pp. 39–50, 7 pl., 2 diag., 1923. [Received 1924.]

The black ash (*Fraxinus nigra*) is subject in various parts of the United States to the heart rot caused by *Polyporus hispidus*. In Michigan the fungus appears to be confined to this tree, though elsewhere it has other hosts. The sporophores, of which as many as seven may occur on the same tree, are usually found in the autumn near branch stumps or in frost cracks or wounds in the upper portions of the main trunk. Their macroscopic and microscopic characters are described.

The normally dark wood is changed by partial delignification to a yellowish-brown colour and reduced to a uniformly soft, spongy mass. As a rule there are no definite lines of demarcation between the rotten and apparently sound regions of the wood, but bordering lines may occasionally be observed in transverse sections, while irregular, dark brown lines are noticeable in radial sections in the decayed wood. The discoloration may also be accompanied by a mottling caused by very fine, white, horizontal lines.

Lignin was found to a slight extent in all the xylem tissues of the diseased wood, the positive reaction in the wood fibres, however, being very faint. Cellulose was detected in the wood fibres, the positive reactions being very faint in other parts of the xylem tissues. Mycelium was found in the medullary rays, vessels, and wood parenchyma.

A much greater part of the tree may be decayed than is superficially apparent. Wefts of mycelium often form small mats in pockets even of seemingly healthy wood, and may be found as far as six feet away from the area usually designated as rotten.

The results of mechanical tests showed a considerable weakening in the crushing strength of the decayed blocks compared with sound specimens.

Some degree of control may be effected by the adoption of certain sylvicultural systems based on a removal of the old stand

and speedy reproduction, brief explanatory notes on which are given.

Noffray (E.). **La rouille hétéroïque des Légumineuses.** [The heteroecious rust of the Leguminosae.]—*Comptes Rendus Acad. d'Agric. de France*, x, 5, pp. 140–141, 1924.

The author advocates the thorough eradication of the cypress spurge [*Euphorbia cyparissias*] from the vicinity of fields or gardens containing leguminous crops, with a view to preserving the latter from the destructive rust, *Uromyces pisi*, which has its aecidial stage on the *Euphorbia* and its other stages on peas and various other Leguminosae. Other useful control measures include burning the refuse from the crop after harvesting and suitable crop rotation.

Böning (K.). **Neue Gesichtspunkte zur Bekämpfung der Brennfleckenkrankheit der Bohne.** [New aspects in the control of anthracnose of Beans.]—*Deutsche Obst- und Gemüsebauzeit.*, lxx, Sondernummer 14 b, pp. 157–158, 1924.

Anthracnose of beans (*Colletotrichum lindemuthianum*), the symptoms of which are briefly described, is stated to be extremely dependent on external climatic conditions as well as on the degree of resistance of different varieties.

The optimum temperature for spore germination is about 22° C., and the development of the fungus is most rapid during damp and warm weather. Heavy, poorly drained, low-lying soils are extremely favourable to the disease. Runner beans are well known to compare favourably with the kidney varieties as regards resistance to anthracnose, presumably on account of their greater distance from the soil. The general substitution of runner for kidney beans, however, cannot be recommended, the cultivation of the former being costly and gradually declining. An attempt should be made to procure a medium form which could be trained to grow up sticks like peas.

Results of extensive observations at the Poppelsdorf (Bonn) Institute for Plant Diseases have shown that the wax and flageolet varieties are particularly susceptible, while Schwert and Prinzess appear completely immune.

Nacion (C. C.). **Study of Rhizoctonia blight of Beans.**—*Philipp. Agric.*, xii, 8, pp. 315–321, 1924.

Lima beans (*Phaseolus lunatus*) and other mat-forming and succulent plants in the Laguna region of the Philippine Islands are liable to attack by a *Rhizoctonia*, which has been identified on cultural and morphological grounds as *R. solani*.

The disease may cause a loss amounting to 40 per cent. of the crop. Seedlings may be attacked at soil level, or the growing points and young leaves of procumbent plants may become infected through contact with the soil. Diseased parts of a plant may also fall over and infect healthy seedlings. In the frequent cases of soil infection the first symptom is the discoloration of the stems just above soil level and the permanent wilting of the leaves. On older hosts sclerotia (1 to 3 by 6 mm.) are formed shortly after

infection. Diseased leaves and stems exude a watery fluid, in which numerous protozoa occur.

The fungus was readily isolated from *P. lunatus* and grown in pure culture. Inoculation tests on seedlings of *P. lunatus* and *P. mungo*, cowpea (*Vigna sinensis*), and soy-bean (*Glycine max*) resulted in the production of the typical *Rhizoctonia* symptoms and in the re-isolation of the causal organism.

Comparative inoculation experiments on potato with the Philippine fungus and *R. solani* from the Department of Agriculture, Washington, produced identical symptoms.

Control measures based on thorough sanitation, planting so as to escape the rainy season, the avoidance of crowding and consequent matting on the ground, the use of sterilized soil, and rotation of crops are recommended.

BURKHOLDER (W. H.). **Varietal susceptibility among Beans to bacterial blight.**—*Phytopath.*, xiv, 1, pp. 1–7, 1924.

In this article an account is given of field experiments carried out at Perry, New York, in 1919 and 1920, and at Ithaca, New York, in 1921, with the object of breeding a bean resistant to bacterial blight (*Phytomonas phaseoli*), which is becoming increasingly prevalent. A large number of varieties of beans [*Phaseolus vulgaris*] were planted in ten-foot rows about 28 to 30 inches apart, and after the plants were a little past the seedling stage they were sprayed with a water suspension of the bacteria. Three or four such inoculations were made. Tables are given showing the susceptibility of the varieties in each year, three degrees of infection being recorded. The year 1920 was unfavourable for blight, but practically all those varieties showing a light infection in 1919 also remained in that class in 1921, demonstrating that those varieties do possess a certain amount of resistance. In general the most resistant varieties are late in maturing and the susceptible are early, but the correlation is not perfect.

TEODORO Y GREGORIO (N. G.). **A study of a Macrosporium disease of Onions.**—*Philipp. Agric. Rev.*, xvi, 4, pp. 233–275, 20 pl., 1923. [Received 1924.]

Leaf mould of the common and Egyptian onion (*Allium cepa* and *A. cepa* var. *bulbellifera*) has been reported from a number of American States and is believed to occur wherever the crop is cultivated. The symptoms of the disease, which is stated to have become destructive of recent years in Wisconsin, where the author's studies were conducted, are described, together with the morphology of both the conidial (*Macrosporium parasiticum*) and ascigerous (*Pleospora herbarum*) stages of the fungus. It is stated that the results of inoculation experiments and cultural studies leave no doubt as to the genetic relationship of the two forms.

Pure cultures of the causal organism were readily obtained. The fungus grew well on a wide range of natural and artificial media, particulars of its cultural characters on certain of which are given. On a favourable substratum, e.g. potato-dextrose agar, the minimum temperature for growth was found to be about 4° C., the optimum 20° to 23°, and the maximum round 35°. The

mycelium and conidia were very resistant to desiccation. Light exerted no perceptible influence on the development of the fungus, the growth of which was, however, entirely arrested by the absence of free oxygen. The maximum development occurred at a hydrogen-ion concentration of P_H 4·4, no growth being observed at a P_H value below 2·8 or above 7·0.

In laboratory tests mature conidia germinated in 4 to 6 hours in water, nutrient decoctions, and agar media. Germination was slow in boiled onion scale extract and practically nil in the unboiled. The spores were killed in copper sulphate solutions at concentrations exceeding 1 in 1,000,000.

Experiments were undertaken to determine the pathogenicity of the organism. The characteristic symptoms of the disease were produced by greenhouse inoculations with the mycelium from young cultures, applied either through wounds or directly to the uninjured tissue. Field inoculations with mycelium and with conidial and ascospore suspensions also gave positive results.

Histological studies showed that the only mode of penetration of the host tissue by the germ-tubes is through the stomata. The hyphae were found to be both inter- and intra-cellular.

The fungus hibernates by means of the mycelium and conidia situated in the dry stems and leaves left on the ground. The destruction of diseased plants and dead tissue is recommended for the control of the disease. Spraying with Bordeaux mixture as practised in Louisiana [see this *Review*, i, p. 407] is regarded as probably too expensive for general use.

Departmental activities : Botany.—*Journ. Dept. Agric. S. Africa*, viii, 1, p. 9, 1924.

The rosette disease of the peanut [*Arachis hypogaea*], which was recently described as new to South Africa [see this *Review*, iii, p. 11], is now stated to occur in Nigeria, where it is well known, and in Tanganyika Territory. While the cause is unknown, the experience in Nigeria is that peanuts sown early in the chief rainy season are practically immune. In the Transvaal the chief rainy season usually coincides with the later crop which is attacked by the disease, though early planting, in agreement with Nigerian experience, will produce a healthy crop.

Rives (L.). **Le court-noué et les mycorrhizes de la Vigne.** [Court-noué and the mycorrhiza of the Vine.]—*Rev. de Vitic.*, lix, 1537, pp. 385–392; 1538, pp. 405–409, 5 figs., 1923. [Received 1924.]

The endophyte of vine roots is of the type which bears vesicles, arbuscles, and sporangioles [see this *Review*, iii, p. 413] and is briefly described. Ectotrophic mycorrhiza also occur in the vine, but are much less common than the other type, which is regarded as due to infection by a weak parasite against which the vine generally reacts in a vigorous manner, causing the disintegration and digestion of the arbuscles. Any weakness on the part of the vine is liable to be accompanied by a more abundant invasion by the endophyte. So also the normal dying-off of the radicles in the autumn is hastened by the action of the endophyte. In periods of

drought this action is accentuated, and the rootlets are killed at a time when their functional activity is of the greatest importance to the vine.

In vines thus suffering from an undue extension of the endophyte the author has found all the symptoms of court-noué [see this *Review*, iii, p. 75, and the abstracts below], and he regards this disease as a symptom of various types of weakened growth due to diverse causes, one of which is the destruction of the rootlets by the endophyte. Even when other causes, such as water-logging, insufficient aeration of the roots, and the like, are responsible for the appearance of court-noué, the accentuated virulence of the endophyte under such conditions may result in an increase in the intensity of the disease.

RIVES (L.). **Le court-noué.** [Court-noué.]—*Rev. de Vitic.*, lx, 1558, pp. 341–349, 1924.

In this paper the author recapitulates the views expressed in a former article [see preceding extract] concerning the relation existing between court-noué of the vine and the endotrophic mycorrhiza, giving the results of further personal observations as well as those reported by others, which confirm the view that the disease is not specific but may result from various causes. Water-logging appears to be the chief of these, but in every case examined by him a great extension of the endophyte was found in the rootlets.

It is considered not unlikely that the growing of resistant varieties may yet prove the best method of checking court-noué. Certain varieties, such as 157–11 and 333 (Cabernet-Berlandieri), are stated to be resistant, and in general the Riparia types are less susceptible than the Rupestris. Other methods of control, chiefly improved soil management, are discussed in some detail.

VIALA (P.). **Actualités : Le court-noué.** [Current events : court-noué.]—*Rev. de Vitic.*, lx, 1550, pp. 211–213, 1924.

The condition known as court-noué of the vine may be due to diverse causes, which include insect and fungous agency, imperfectly drained soils, frosts, and, in the case of certain varieties, excessive productivity. Rives [see preceding abstracts] has been led to refer certain forms of court-noué to the action of endophytes. Apart from all these causes, which have in common the production of shortened internodes and adventitious shoots, there are court-noué cases of a special and severe nature, the origin of which remains unknown. This form must be regarded, not as a symptom only, but as a real disease which appears to have spread and become more of a menace year by year, especially during the last fifteen years. In these cases the plants become stunted, lateral branches develop in great numbers, and the leaves diminish in size, their surface being at times covered with yellow spots like those of certain potato diseases of the degeneration type. The author thinks that further research may discover a relationship between these diseases, especially as in the type of court-noué described suckers seem to transmit the trouble, though no specific organism has been isolated either in the plant tissues or in the soil.

VIALA (P.). **Le court-noué.** [Court-noué.]—*Comptes Rendus Acad. d'Agric. de France*, x, 5, pp. 135–138, 1924.

The author's views on the condition known as court-noué [see last abstract] were explained at a meeting of the Academie d'Agriculture de France. In the course of the subsequent discussion, P. Gervais stated (pp. 139–140) that he had tested all manner of remedies, including sterilization of the soil with carbon bisulphide, aeration of the sub-soil, and painting of pruning wounds with tar and the like, with absolutely negative results. He confirmed the observation that the most susceptible varieties are Rupestris and its hybrids, the root-system of which extends far down into the soil, while those varieties of which the root-systems form a superficial network are less frequently and severely attacked.

GAUCH (A.) & DURAND (J.). **Le court-noué.** [Court-noué.]—*Prog. Agric. et Vitic.*, lxxxi, 13, pp. 323–327, 1924.

This is the report of a Commission [including, besides the two authors, Messrs. J. Bertrand and J. B. Gèze] appointed by a French Agricultural Society (La Société Départementale d'Encouragement à l'Agriculture de l'Hérault) to inquire into the court-noué disease of the vine.

After describing the characteristic symptoms of the disease and tracing its history and distribution, an account is given of the conclusion reached by various investigators, some of whose work has already been noticed [see preceding and following abstracts]. The cause of the trouble is still unknown, but the work to date has enabled the Commission to tabulate the factors which favour, and those which do not favour, the occurrence of the disease. It is more frequently found and is more virulent in low-lying, waterlogged vineyards; in heavy soils and in those consisting chiefly of silt; on deeply planted vines; in vineyards too heavily cultivated; on vines replanted in soil from which diseased vines have been removed; on vines which bud early and on those of late growth; on deep-rooted stocks, such as *Vitis rupestris* and its hybrids; after late frosts; in rich, well cultivated, and highly productive soils. On the other hand, it is seldom present in the high, well-drained parts of a vineyard; in light soil; on shallow-planted vines; in virgin soils, or those in which several crops of cereals intervene between successive plantings of vines; in vineyards cultivated superficially; on vines which bud late (Grand Noir, Carignan, Bourrets); on shallow-rooted stocks (Riparia); in years where the spring is hot and dry; in vineyards of small yield and bad cultivation; in vineyards planted with fruit trees or where the distances between the plants are small; in cases of reduction of vegetative growth by extensive pruning; and in vines where pruning is carried out only on shoots arising directly from the stock.

The Commission, after carefully weighing the evidence collected *in situ* by its members and that recorded by other investigators, suggests that the trouble may possibly have its origin in a lack of vitamines or their equivalent, owing to the inhibition by unfavourable conditions of the action of the micro-organisms of the soil, which are thought to produce the factors indispensable to the

proper development of plants. This theory is stated to fit the observed facts satisfactorily, and it is recommended that the avenue of research it opens up should be explored with a view to determining the rôle of soil organisms in the production of these vitamines.

The remedial measures employed in actual practice are discussed, but they are stated not to have given satisfactory results. Recommendations for the setting up of a research committee for the further study of court-noué, which is becoming a menace to French vineyards, are outlined.

A bibliography of the chief publications on the disease in France is given.

CHAPPAZ (G.). **Le court-noué.** [Court-noué.]—*Prog. Agric. et Vitic.*, lxxxi, 20, pp. 469–474, 1924.

The author describes a form of court-noué of the vine which he attributes to the effects of frost. Affected plants are late in opening their buds and the resulting shoots are deformed in a characteristic manner, the internodes being very short and deflected from a straight line so that growth progresses in zigzag fashion. The shoots are generally flattened, fluted, and their surface covered with black dots, a condition which was formerly termed 'dotted anthracnose', and also with cracks resembling the marks of 'dartrose'. More rarely, the surface of the stunted shoots is black and as if varnished. All these marks are, however, superficial. The leaves growing on these shoots are small, deformed, and with a ragged margin, while the surface between the veins is often bulging and sometimes covered with reddish stains. The fruit, though very sparse owing to the abortion of the flowers, is not reduced in size, but is dotted and cracked. In severe and early cases of court-noué many secondary buds develop on the old wood, as always occurs after a severe frost. Sometimes the shoot is normal at the base, malformation only starting at the third or fourth internode, and in these cases the secondary development of buds does not take place. The author emphasizes the fact that the form of court-noué described disappears completely with the summer heat and the plant regains its normal aspect.

Several examples from actual experience are given in support of the theory that frost is responsible for this disease, and the observed fact that the disease is more prevalent on grafted than on the old French vines is explained by the tendency of certain stocks to early budding.

Regarding the hereditary character of court-noué, it is stated that this is far from being the rule. Nevertheless, the precautions usual in grafting must be observed, i. e. shoots affected with the disease should be discarded.

The author is of opinion that in most cases a thorough cutting back of the vines, which are least deformed at the base, will suffice to check the trouble. A certain length of shoot may be left in each vine thus treated, in order to ensure the production of fruit. The operation of nipping off buds, when well carried out, contributes to the improvement of the wood as soon as the vine

becomes bushy, while the generous application of sulphur favours growth on the appearance of warm weather and may save part of the harvest.

Ravaz (L.) & Verge (G.). **Le rougeau de la Vigne.** ['Rougeau' of the Vine.]—*Prog. Agric. et Vitic.* lxxxi, 1, pp. 11–17; 2, pp. 35–38; 3, pp. 86–89; 4, pp. 110–113; 5, pp. 135–141, 2 col. pl., 11 figs., 1924.

The condition known as 'rougeau' [reddening] of the vine is generally associated either with physiological accidents or with soil or climatic influences. Though it must have existed as long as the plant itself, the authors have not found it mentioned in the literature previous to 1883. It seems to occur sporadically, and after a comparatively long period of quiescence, violent outbreaks were recorded in 1920 and 1921 in the Aube Department and in the south of France.

Rougeau may bring about the death of the plant, but the rate of progress and the outward symptoms vary. Growth is generally quite normal until the autumn, during or after the harvest, when the leaves redden from the margin inwards, first the veins and then the parenchymatous tissues being affected. The coloration may be arrested at any stage of its progress, or it may gain the whole leaf surface, the shades of red varying according to the variety of the vine from pink through bright red to purple-red, and occasionally bronzed. In white varieties, however, the leaves turn pale yellow and the name 'rougeau' is obviously misleading; the authors propose that of 'flavescence' in this case. Later on, brown patches formed by the dead tissues cover the discoloured leaves, the progress being again from the margin inwards; finally the leaves wither and fall prematurely. Under damp conditions the brown patches are covered with various moulds, which modify their appearance. At times the markedly red leaves become thickened, shiny, and brittle, with a parchment-like aspect, and instead of drooping they tend to become erect. In such cases they remain attached to the branches longer than the normal foliage and are less susceptible to frosts; their margins curl downwards, as occurs also in leaves affected with flavescence.

The process of assimilation in diseased leaves is considerably impeded, and transpiration is reduced. In the first stages of the trouble the shoots do not materially differ from the normal, except that the terminal portion is not fully developed, but after July of the following year, subsequent to a belated initial growth, they lignify only partly or not at all and tend to droop. After the fall of the leaves the undeveloped portions of the shoots wither from the apex downwards. The grape clusters sometimes reach normal dimensions but are unable to ripen, and dry up before the harvest. In the year following, growth is still more impeded; shoots do not form freely and the branches which do grow are frail and thin. The vine is very much weakened and dies in the course of the year, unless conditions become unfavourable to the disease. The main stem does not at first show any outward symptoms. In the second year, however, longitudinal grooves, due to uneven growth in diameter, appear, especially on the underground portion of the

stem, giving it a fluted aspect. The bark is very closely adherent, and the very numerous roots frequently form a tangled mass.

Sections of affected leaves show a brown discoloration in the phloem of the veins, owing to the death of some of the cells, which collapse while the neighbouring healthy cells proliferate irregularly. Little or no alteration is seen in the xylem. Between the palisade layer and the spongy tissues of the reddened leaf parenchyma are found brown, dead cells which cause the withered patches visible on the leaf surface. In the branches a very considerable development of the soft bast takes place, but the sieve-tubes are either absent or only partly formed and the bast fibres are undeveloped, this probably accounting for the brittleness of affected branches. All the cells are empty or nearly so. The phloem of the fluted portion of the stem is also without fibres and sieve-tubes. The reddish coloration of the roots is due to the presence of cells (especially in the cortex) containing a homogeneous colouring substance which dissolves in alcohol.

The disease is most pronounced in heavy, compact, badly drained soils.

A very similar trouble (Roter Brenner) in Switzerland is attributed by Müller-Thurgau to the fungus *Peziza tracheiphila*, but the authors were unable to find any trace of this parasite in the French form of the disease. *Exobasidium vitis* develops freely on affected leaves, but it is clearly not responsible for the condition. In the Beaujolais district the trouble has been ascribed to the practice of tying up the shoots, and the authors' experiments have shown that leaves above a ligature will redden, while those below it remain green. Under certain conditions even a very slight compression, if continuous, will produce the symptoms. The following causes are also responsible for rougeau: (1) encircling lesions, which destroy the bark and phloem tissues, provided cicatrization does not take place before the autumn; (2) the partial breaking or torsion of a branch, or the destruction of the bark through insect or fungous agency (e.g. *Botrytis cinerea* or *Coniothyrium diplodiella*); (3) frosts which, like those in 1921, weaken the portion of the stem nearest the soil level and leave the crown and the roots of the plant more or less intact; (4) the rapid growth of the young suckers which may become compressed through the resistance of the soil; (5) the interlacing of the roots which tend to strangle each other; (6) excessive moisture. Stagnant water tends to asphyxiate the roots, and this explains the tendency to rougeau in compact, heavy soils.

All these apparently diverse causes can, it is stated, be referred to one central phenomenon, namely, the destruction of the equilibrium between the elaboration and consumption of carbohydrates in the course of the vegetative period. The upsetting of this balance in any direction results in rougeau.

In discussing control measures the authors recommend care in applying ligatures. If the trouble is due to weakness of the plant, fertilizers in which potash predominates must be applied copiously. The rougeau due to soil conditions is best eliminated by suitable cultural methods, with special attention to drainage.

Gram (E.) & Rostrup (Sofie). **Oversigt over Sygdomme hos Landbrugets og Havebrugets Kulturplanter i 1923.** [Survey of diseases of agricultural and horticultural cultivated plants in 1923.] – *Tidsskr. for Planteavl*, xxx, 3, pp. 361–414, 1 map, 1924. [English Summary.]

The period under review (1st October 1922 to 30th September 1923) was characterized by a mild, sunny winter with a considerable rainfall, but little snow, followed by an abnormally cool and damp spring and summer. The diseases of the chief agricultural and horticultural crops are grouped under the following headings, numerous records being given besides those mentioned below.

Cereals. Stripe disease of barley (*Pleospora graminea*) occurred very generally, especially on the Karl, Prentice, and Guld varieties, Binder being resistant. Net blotch (*P. teres*) was also common, particularly in lodged crops. Yellow rust (*Puccinia glumarum*) was found in a number of wheat fields on the Trifolium and Pansar II varieties (usually resistant). Foot rot of wheat, barley, and oats was very prevalent, especially in conjunction with defective cultural measures; it was frequently impossible to determine which of the causal organisms (*Fusarium, Ophiobolus*, or *Leptosphaeria*) was implicated.

Beets. Mosaic was prevalent but not severe, except where the new crop was grown in proximity to seed bearers from the previous year. Root rot (*Pythium de Baryanum*) was associated with faulty methods of cultivation, including excessively deep sowing, early sowing in poor, cold soil, the absence of lime, and the like. Wilting of beets, which occurred in different localities, was associated at Lyngby with the presence of *Phoma betae*.

Cruciferae. Mosaic disease of turnips was reported from various districts. *Peronospora parasitica* attacked cauliflowers under glass in the autumn, and developed extensively on the spring seedlings. Dry rot of swedes (*Phoma napobrassicae*) caused considerable damage. The black ring disease of horse-radish, believed to be due to *Verticillium* sp. [see this *Review*, iii, p. 10], occurred extensively. The same host was severely attacked by *Cystopus candidus*, which had to be combated by the application of Bordeaux mixture, and by *Ramularia armoraciae*.

Umbelliferae. Carrots were very generally attacked by *Hypochnus solani, Sclerotinia sclerotiorum*, and *Phoma rostrupii*. *Alternaria brassicae* var. *dauci* and an undetermined *Alternaria* caused extensive damage to carrot seedlings, the stem below the umbels and the root collar being the main points of attack.

Potatoes. Leaf roll was much less severe in 1923 than in 1922, especially in the north and west of Jutland. Mosaic is more widely distributed over the country than leaf roll, but is generally less destructive; early varieties growing in gardens appear particularly susceptible. Wart disease (*Synchytrium endobioticum*) was reported for the first time in Denmark from two localities; stringent precautions are being taken to prevent its spread.

Fodders. *Gloeosporium caulivorum* occurred in a virulent form on early red clover from Switzerland and Czecho-Slovakia, the stems and leaves withering before the plants flowered. This is stated to be the first record of the disease in Denmark.

Fruit. A sudden wilting of plum, cherry, and myrobalan trees was found to be associated with the attacks of a bacterium (? *Bacillus spongiosus*) in the bark. *Didymella applanata* is stated to be greatly on the increase in raspberries, of which the canes were also attacked by a red fungus (*Fusarium salicis*), causing wilting.

Cucurbitaceae. Mosaic was prevalent in greenhouses in the Copenhagen district. A bacterial wet rot of the base of the stems caused considerable damage to greenhouse cucumbers of the Tottenham and Butcher varieties. A dry rot was found to be associated with a species of *Fusarium*. A fungus identified as *Sporidesmium mucosum* var. *pluriseptatum* produced symptoms resembling those of *Cercospora melonis*.

Ornamental Plants and Trees. Pyramid poplars were attacked by a species of *Marssonina* producing black spots on the leaves and defoliation. In 1922 and 1923 a number of 10 to 15 year old elms at Aarhus suffered from a die-back of the twigs accompanied by conspicuous attacks of *Nectria cinnabarina*. An examination of the affected areas of the bark, however, revealed the presence of *Phoma oblonga*, which is regarded as the primary parasite.

Physiological Diseases. Leaf scorch of currants [see this *Review*, iii, p. 257] appears to be curable by the application of liquid manure.

Yellow spotting of cereals was prevalent, especially in barley following sugar beets or swedes and on early sown crops on low-lying ground or cold soil. The application of potassium to the soil has given beneficial results.

Yellow tip [see this *Review*, i, p. 209] was observed in one case to occur all over a field following one year's grass, with the exception of a small portion which had been preceded by three years' pasturage.

Bright speck [see this *Review*, ii, p. 488] occurred on cereals and beets, under the usual conditions and also on loamy soils. A severe attack on rye was associated with the presence of *Septoria* (? *nodorum*), inoculation experiments with which, however, gave negative results. Beneficial effects followed the application of manganese sulphate and, in one locality, the choice of a sheltered site was advantageous.

A disturbance which appears to partake of the nature both of yellow tip and bright speck occurred on oats (and to a slight extent on barley) in central and west Jutland. The apical leaf turns white or yellow and finally wilts, while the lower leaves exhibit the same symptom in a milder form ; the axis, if developed, is pale and feeble. The attack occurs in patches in the field, as in the case of bright speck. The application of manganese sulphate failed to control the disease, possibly because it was given too late.

Fungicides. Elosal and oidal proved useful against the Erysiphaceae, the former giving uniformly good results in the control of rose mildew [*Sphaerotheca pannosa*], while the latter is particularly notable for its excellent power of adhesion. The so-called 'Harpix' soap (Harpix 2 kg. ; potassium carbonate 1 kg. ; water 7 kg.) resulted in a great increase of adhesiveness in the mixtures to which it was added.

Fortieth Annual Report of the Director, Wisconsin Agricultural Experiment Station, 1922–1923.—*Wisconsin Agric. Exper. Stat. Bull.* 362, 114 pp., 40 figs., 1924.

The following references of phytopathological interest (other than those already noticed in this *Review* from different sources) are contained in the Report.

The breeding of pedigree barley for freedom from bacterial stripe disease has been continued, no evidence of infection being discovered during the period under review. The propagation of the strain will be continued until a sufficient quantity is available for general distribution.

Important phases in the life-history of the apple scab fungus [*Venturia inaequalis*] have been investigated by Keitt and Jones in connexion with the time of infestation of leaves and fruit. Field and greenhouse studies showed that temperature and humidity cause marked variations in the development of the causal organism, the susceptibility of the host at critical periods, the inception and development of the disease, and the action of fungicides. The ascospores of *V. inaequalis* have been found to mature considerably earlier in the spring than was formerly supposed, moisture and temperature being apparently the most important factors limiting their natural discharge. The addition of a 'pre-pink' application of a suitable spray to the usual control programme has given satisfactory results.

It has been found that the usual pre-blossom spray is superfluous in the control of cherry leaf spot [*Coccomyces hiemalis*], owing to the late appearance of the disease, in the principal cherry-growing area of the State.

Investigations on the relation between temperature and disease by Gilman and Tisdale showed that, in the case of cabbage yellows [*Fusarium conglutinans*], the higher the temperature within the usual field range, the worse the disease. On the other hand, healthy plants may be grown even in the most severely infested soils if the latter are kept continuously cool. The 'critical' soil temperature is stated to be 62° F., below which the plants escape the disease even when the parasite is abundant in the soil, while above this point they become progressively worse. The corresponding 'critical' temperature for flax wilt [*F. lini*] was found to be about 56° F. Soil moisture was shown to be of less importance than soil temperature.

Root rot of tobacco [*Thielavia basicola*] was found by Johnson and Hartman to be favoured by low soil temperatures. This observation explains the frequent sudden recovery, during the high temperature of August, of plants which have remained stunted throughout the cool early summer.

Smith (C. O.). **The study of resistance to crown-gall in Prunus.**—Abs. in *Phytopath.*, xiv, 2, p. 120, 1924.

Tests of species and varieties of *Prunus* for crown gall [*Bacterium tumefaciens*] resistance, by artificial inoculations, have revealed great differences in susceptibility. In *P. domestica* susceptible and resistant varieties have been found; in other species (which are listed) all the members of the species show strong or (in

certain evergreen species) total resistance. Resistant species are being tried as stocks for stone fruits under Californian conditions, and *P. mume* and *P. besseyi* appear promising. The resistant hosts of *Prunus* in many cases show small hypertrophies, which, however, usually disappear after a time.

LEVINE (M.). **Studies on plant cancers. VI. Further studies on the behavior of crown gall on the Rubber plant, Ficus elastica.**—*Mycologia*, xvi, 1, pp. 24–29, 1 pl., 1924.

Continuing his studies on the effect of *Bacterium tumefaciens* on *Ficus elastica* (see *Mycologia*, xiii, pp. 1–11, 1921), the author describes the course of events following the death of the inoculated branch. The nearest axillary bud below the dead region grows out into a small branch and, later on, this is followed by the bursting of a number of dormant axillary buds below, in the same way as when a branch is decapitated.

This suggests that the development of buds, after inoculation into the axillary leaf buds of a stem, is not due to the effect of bacteria but to a localized mechanical stimulation similar to decapitation. The complete stimulative effect is inhibited by the crown gall cells or the bacteria and only when complete necrosis occurs is the mechanical stimulus allowed to act.

Inoculations on old stems of *Ficus elastica* are also described. Despite their age, the stems responded very rapidly, the crown galls forming a woody structure which could easily be removed from the trees by slight lateral pressure.

MUNERATI (O.). **Le basse temperature al momento della germinazione fanno sfuggire il Grano all'attacco della carie ?** [Is bunt prevented from attacking Wheat grain by low temperatures at the time of germination ?]—*Rendic. Accad. Lincei*, xxxii, ser. 5, 6, pp. 285–289, 1923.

In 1922 the author carried out a series of experiments in which two varieties of wheat (Gentile Rosso and Cologna) strongly contaminated with spores of *Tilletia* were germinated under controlled conditions as regards soil temperature. In beds 1 and 2 the seed-beds were kept during the whole period at from 22° to 25° and at 10° to 12° C. respectively; in seed-bed 3 the temperature was 2° to 4° C. for the first 20 days, and then 22° to 25°; in 4 the temperature was the same as in 3, but with a period of 7 days at 10° to 12° after the first 20 days; in 5 the temperature was kept at 2° to 4° during 40 days, and was then allowed to become normal. After five weeks the seedlings were considered to be immune from subsequent attack. They were set out in the open field where they grew to maturity.

The Gentile Rosso plants in beds 1, 3, and 5 had no bunt in 604, 247, and 235 ears respectively. Those in bed 2 had 143 out of 940 bunted, and those in bed 4 had 86 out of 349 infected. The Cologna plants were somewhat more susceptible and had a few ears attacked in beds 1 and 5, but the general results were the same.

Woolman (H. M.) & Humphrey (H. B.). **Studies in the physiology and control of bunt, or stinking smut, of Wheat.**—*U.S. Dept. of Agric. Bull.* 1239, 29 pp., 5 pl., 3 diag., 1924.

The results of experiments on the physiology and control of bunt of wheat (*Tilletia tritici* and *T. levis*), extending from 1913 to 1921, are described in some detail.

In 1915 wind dissemination of the spores was shown to be the most important factor in the continued propagation of the disease in the Pacific Northwest, where the biennial system of rotation is practised.

The spores of the fungus were found to lose their viability in one to two months in damp soil. In unbroken smut balls they retain their viability throughout the winter months, even when subjected to alternate freezing and thawing, and they have produced infection after being $1\frac{3}{4}$ years in the soil. When continually subject to the dry air of the laboratory or herbarium, bunt spores retain their germinating power for 12 years or more.

At Pullman, Washington, the minimum, optimum, and maximum germination temperatures for *T. tritici* were found to be respectively 0° to 1°, 18° to 20°, and 25° to 29·1° C. Wheat sown in soil at a temperature above 20° was practically immune from infection from seed-borne spores, but not necessarily from those already present in the soil. Spores exposed for five days to a temperature of 29·1° failed to germinate when transferred to the optimum. The presence of free oxygen was shown to be essential to the germination and normal growth of the bunt spores. The optimum soil-moisture content for infection in the basaltic soil of the Palouse country lies between 16 and 30 per cent.

The fungus is capable of entering the seedling at any point along the coleoptile, and under experimental conditions infection may result after the production of the first leaf.

A direct correlation was found between the depth of sowing and the percentage of infection, which became almost uniformly higher as the depth increased from 0·5 to 3 inches.

A wide range of varietal susceptibility, apparently not determined by vigour, rapidity of growth, or early ripening, was observed.

Much of the seed wheat sown in the semi-arid regions of the western United States is stated to be killed by treatment, owing to threshing injury to the seed-coat. Partial protection against spores present in the soil has been obtained by the use of copper sulphate or lime-sulphur, applied at full strength and allowed to dry. Formaldehyde did not give similar results. Burying the spores below the seed-bed by reploughing the summer fallow should assist in the control of bunt. The disease is stated to be entirely preventable by sowing treated seed before the spore shower, and largely controllable by delaying the process until the termination of the saprophytic existence of the organism.

Tehon (L. R.) & Young (P. A.). **Notes on the climatic conditions influencing the 1923 epidemic of stem rust on Wheat in Illinois.**—*Phytopath.*, xiv, 2, pp. 94–100, 1 graph, 1924.

Observations on the development of stem rust of wheat (*Puc-*

cinia graminis) were made by workers of the Illinois Natural History Survey from the date of the appearance of the 1923 epidemic to harvesting. These observations were correlated with climatological data, and indicate the influence of temperature and moisture in the development of an epidemic.

Five early records of stem rust were made between 4th and 14th June; in each case only a very few culms in any one spot showed infection, the five were located well within the field, were isolated from each other, and had uniformly a high percentage of the maximum possible area covered by pustules. No information was obtained as to the source of the inoculum, but it is assumed to be the uredospores which overwinter in the field or on wayside grasses. From 16th June onwards the dissemination of the rust from the original foci became apparent, and by degrees the infection of entire fields was accomplished, the secondary and succeeding infections being gradually less severe and developing smaller areas covered by the pustules.

Moisture, which in the field is closely allied to precipitation, was an important factor in the development of primary infections. There was an apparent correlation between periods of precipitation and the occurrence of the infections recorded above. Data are given of the temperature and precipitation for 10 or 13 day periods preceding the finding of the primary infections. In the first case, rain fell on all but one day during the 10-day period, in the second on all but 3 days in the 13-day period, whilst in the other three cases, smaller quantities of rain had fallen over a shorter and generally earlier period, sufficient, in one case at least, to provide favourable conditions for spore germination.

Even when favourable moisture conditions obtain, however, proper temperatures are required for spore germination and host infection. The data on temperature in each of the primary infections are separately considered; in the first case infection probably took place 8 to 4 days before the symptoms were noted, when the average mean temperature was 73·5° F.; in the second, a period occurred when the mean temperature was 72·3°, 8 to 4 days before the symptoms were recorded; and in the other three cases, from the climatological data available, no satisfactory surmise can be made, although rain fell at the nearest recording station from 7 to 5 days before the symptoms were noted, the mean temperature of these three days being 76°. The corresponding data for the secondary and later infections appear in general to conform with the above observations on primary infections.

SMITH (N. J. G.). **The parasitism of Helminthosporium gramineum, Rab. (Leaf-stripe disease of Barley). Abstract.**—*Proc. Cambridge Phil. Soc.* (*Biol Sci*)., i, 2, pp. 132–133, 1924.

The results of a re-investigation of the life-history of *Helminthosporium gramineum*, the cause of stripe disease of barley, have satisfied the author that Ravn (*Zeitschr. für Pflanzenkrankh.*, xi, p. 1, 1901) was mistaken in believing the fungus to inhabit the growing point of its host.

The attack on the germinating seed is stated to occur while the shoot is still under the adherent glumes or during its emergence,

which usually occurs at the awn end of the grain. The sources of attack comprise (*a*) conidia, mainly lodging at this end; (*b*) mycelium penetrating from the glumes, if these have been infected while green from the parent or another plant; and (*c*) perithecia formed inside or outside the glumes. From these sources the mycelium penetrates the outer surface of the coleoptile and spreads in its tissues. No invasion of other parts occurs until the first leaf, rolled up inside, is near emergence, by which time the hyphae have reached the inner surface of the coleoptile and come into contact with the upward-pushing first leaf. The inrolled part of the latter escapes penetration at this stage, as does a larger or smaller proportion of the exposed surface, owing to the variable amount of mycelium which has traversed the coleoptile. The expanding leaf shows one or more pale stripes of invaded tissue, the stripe being partly due to the upward growth of the leaf brushing a vertical stripe against externally applied hyphae, and in part to the barrier to the lateral spread of the mycelium provided by the vascular bundles. The second leaf is in turn infected by the enclosing sheath of the first, and so forth.

After all the surrounding sheaths have been infected, a fatal penetration of the growing-point sometimes occurs. The presence of mycelium in the stem, penetrating from the surrounding diseased leaf sheaths, is a secondary phenomenon; it is usually left fragmentary and innocuous among the hardening nodes and elongating internodes. Sooner or later (according to the amount of the fungus present and the conditions affecting its spread) the ear becomes infected from its enclosing sheath. A correspondingly severe or mild degree of discoloration results, the latter being the more dangerous as not ensuring rejection when seed grain is chosen. The weakening of straw and awns through the attacks of the fungus, and the mummification of the auricle of the last leaf, produce imperfect emergence of the ear.

The host-parasite relations thus outlined clearly differ widely from those of the smuts. On the other hand, analogous phases occur in other *Helminthosporium* diseases. Thus in cases of seed infection by *H. avenae* and *H. teres* the stripe form of attack on the first leaf may occur. There is also some evidence, not yet fully authenticated, that a foot rot of barley, similar to that caused by *H. sativum,* can be induced by *H. gramineum* under conditions differing from those which produce leaf stripe.

Barney (A. F.). **The inheritance of smut resistance in crosses of certain varieties of Oats.**—*Journ. Amer. Soc. Agron.*, xvi, 4, pp. 283–291, 4 figs., 1924.

A study was made of the inheritance of resistance to loose smut (*Ustilago avenae*) in a number of crosses of oat varieties.

The parent and F_1 plants of the crosses discussed in the present paper were grown in the greenhouse. The F_2 individuals of one group of crosses, and the F_3, F_4, and F_5 generations of other crosses, were grown in the field. The seed was inoculated by placing it in an envelope containing a few ounces of spores and thoroughly shaking the mixture, the excess spores being removed through

a strainer. Control plants from non-inoculated seed remained healthy.

The parent material consisted of the following 12 varieties: Aurora, Burt, Black Mesdag, Black Tartarian, Cornellian, Fulghum, Gold Rain, Lincoln, Swedish Select, Turkish Rustproof, White Tartarian, and a strain of *Avena sterilis.* The data presented in this paper are taken from three characteristic crosses, as detailed below, together with 70 F_2 families from crosses between Early Ripe and Black Mesdag, and Sixty Day and Black Mesdag, obtained from the Department of Plant Breeding and studied for resistance through the third, fourth, and fifth generations.

Preliminary tests with the parents indicated that Black Mesdag, Burt, and Fulghum are resistant to smut; Gold Rain intermediate; and Swedish Select and Turkish Rustproof highly susceptible. An analysis of the data from the F_2 generation of crosses indicates that the latter naturally fall into three definite groups, segregation in which has been interpreted on the basis of one, two, and three independent factor pairs.

Cross 5 (Fulghum × Black Mesdag) is presented as characteristic of the seven crosses included in group 1. The ratio of smutted to non-smutted plants was 2·47 to 155·53. Segregation in this group is interpreted on the basis of three independent factor pairs.

Of the five crosses included in group 2, cross 21 (Swedish Select × Burt) has been selected as typical. The ratio of smutted to non-smutted plants was 9·63 to 144·37. Segregation is interpreted on the basis of a difference of two independent factor pairs in the parents.

Cross 37 (Turkish Rustproof × Gold Rain) has been selected to represent the four in group 3, segregation occurring on the basis of only one factor pair. The ratio of smutted to non-smutted plants was 78·76 to 236·24.

As a tentative suggestion the following are offered as possible combinations to account for the three types of segregation noticed:

Cross 5	SS s′s′ s″s″	× ss S′S′ S″S″
„ 21	ss s′s′	× SS S′S′
„ 37	ss	× SS

In each case the factor S is responsible for resistance.

The three crosses presented are stated to approach very closely to anticipations according to the basis of interpretation. The following results may be expected, if the above suggestions be sound, in the F_3 generations from the various groups. Where segregation occurs on the basis of three factor pairs 37 of the 63 F_2 genotypes will breed true for resistance, 12 progenies will segregate into a 15 : 1 ratio, and 6 into a 3 : 1 ratio, while the 8 remaining progenies will revert to a 63 : 1 ratio. Where two factor pairs are involved, about 7 of the 15 resistant F_2 genotypes will breed true for resistance, 4 will segregate into a 15 : 1 ratio, and 4 into a 3 : 1 ratio. Where there is only one factor pair, one of the three resistant F_2 genotypes will breed true and two segregate into a ratio of 3 : 1.

As regards the 70 families mentioned above, a difference of one

factor pair in the parents is strongly indicated. A total of 22 families was found in the resistant class, 32 in the intermediate, and 16 in the susceptible. All classes tended to breed true to their respective types through successive generations (to F_5).

BRANSTETTER (B. B.). **Corn root rot.**—*Missouri Agric. Exper. Stat. Circ.* 117, 8 pp., 4 figs., 1924.

Root rot of maize, the symptoms of which are described, is stated to be largely controllable in Missouri [see this *Review*, ii, p. 213] by hand selection of the seed, the results of tests with the rag-doll germinator being so far inconclusive. The following are the chief points to remember in field selection: the ears should be firm and heavy, free from all signs of fungous trouble, and with clean, bright, cob tips; ears with brittle kernels should be rejected. Maize should not be grown on the same field more than two years in five. The use of phosphates, and of lime on acid soils, is recommended.

GADD (C. H.). **Further observations on the nut fall of Coconuts.**—*Year Book Dept. of Agric., Ceylon,* pp. 16–20, 1 chart, 1924.

The results of experiments on the use of Bordeaux mixture as a preventive of nut fall of coco-nuts [see this *Review*, ii, p. 543] were inconclusive but tended to show that this form of treatment cannot be relied upon for complete control. The sprayed plots certainly gave higher yields both in 1921 and 1922, but the author regards this less as a direct result of the treatment than as due to inherent differences in cropping capacity.

The noticeable increase in the fall of 'button' nuts (fruits not more than two months old) during June, July, and August appears to be a seasonal factor connected with the general rise in production at this time. The presence of an excessive number of female flowers is necessarily correlated with a heavy fall of buttons.

No fungous disease has been found associated with nut fall in Ceylon. In 1922 the incidence of nut fall was below the average during the rainy season both in treated and untreated plots, which would hardly have been the case if *Phytophthora* were involved.

Mechanical injuries, such as the fracture of a branch, are frequently responsible for nut fall. This is particularly noticeable in palms which produce their nuts some distance up the branch.

SCHWARZ (M. B.). **Botrytis stephanoderis n. sp. Bally und Botrytis bassiana Bals.** [*Botrytis stephanoderis* n. sp. Bally and *Botrytis bassiana* Bals.]—*Bull. Jard. Bot. Buitenzorg, Sér. 3,* vi, 1, pp. 68–69, 1924.

The author maintains that *Botrytis stephanoderis* [see this *Review*, ii, p. 368], the fungus attacking the coffee berry borer, *Stephanoderis hampei*, does not differ sufficiently from *B. bassiana* to justify the creation of a separate species, such divergences as were observed being in all probability due to the protracted subculturing of *B. bassiana* at the Centraalbureau voor Schimmel-

cultures before its comparison with the freshly isolated Java material.

A further objection to the name *B. stephanoderis* is that it implies specialization on the coffee berry beetle, whereas the fungus in question has been isolated also from *Brachartona* larvae collected by Leefmans in Java and from caterpillars of the white rice-borer collected by Van der Goot.

THAYSEN (A. C.) & BUNKER (H. J.). **Studies of the bacterial decay of textile fibres. I. Variations in the resistance of Cotton of different origins to destruction by micro-organisms.** —*Biochem. Journ.*, xviii, 1, pp. 140–146, 1 diag., 1924.

It has already been shown (*Biochem. Journ.*, xv, p. 407, 1921) that the susceptibility of raw cotton fibre to destruction by micro-organisms, which in the United States alone is stated to cause an annual loss of \$70,000,000, appears to vary with their country of origin. American cottons were found to show greater resistance than Egyptian, and the latter than Indian. This observation has now been confirmed on a total of 15 different American, 15 Egyptian, 35 Indian, and 8 Indo-American cottons.

The connexion between the presence of food substances and the rate of destruction of cotton fibres was determined by a test in which an American, an Egyptian, and an Indian cotton were wetted with water containing 0·1 per cent. each of peptone and potassium hydrogen phosphate. The percentage of decomposed fibres after 42 days incubation at room temperature (16°) was 21 in the American, 35 in the Egyptian, and 39 in the Indian. Samples exposed to bacterial attack without the nutrient solution showed the following rate of deterioration: American 12 per cent. after 34 days; Egyptian 15 per cent. after 30 days; and Indian 28 per cent. after 20 days. Thus the rate of destruction is comparatively little affected by the addition of a nutrient material. The behaviour of American cotton grown in India, however, was quite different. After 42 days at room temperature the percentage of decomposed fibres in Cawnpore-American wetted with distilled water was 2, with tap water 4, and with the food solution mentioned above 44. Similar results have been obtained with other strains of Indo-American cotton, the natural resistance of which may reasonably be ascribed to the absence from the fibres of sufficient food for the development of micro-organisms. The sample of Cawnpore-American cotton referred to above had not been crossed with pure Indian strains, so that its loss of resistance in India as compared to America, when wetted with a nutrient solution, must have been due to climatic or soil conditions.

Another experiment was directed to ascertain whether the fibres of the true American and Egyptian cottons contained substances inhibitory to the growth of bacteria. One sample of Sakel Combed Silver Egyptian cotton was damped with distilled water containing a food solution as above, infected with cellulose-destroying organisms; a second sample was boiled for 30 minutes in distilled water at atmospheric pressure, and then treated like the first; while a third was heated with 3 per cent. NaOH at 45 lb. pressure and treated like the two others. The rate of decomposition after

30 days was 33 per cent. in the first sample, 26 per cent. in the second, and 14 per cent. in the third. Thus the treatments designed to remove the inhibitory substances appeared to increase rather than reduce the degree of resistance.

The assumption that resistance might be correlated with the presence of a thicker or more impenetrable cuticle does not appear to be justified, since the treatment with caustic soda retarded rather than accelerated the destruction. The high degree of resistance of American and Egyptian cottons is maintained, moreover, even after the collapse of the cuticle. The factor determining resistance appears, therefore to reside in some physical or chemical property, as yet undetermined, of the cellulose.

The value of various food substances for the rate of deterioration of Indo-American cottons was investigated. Peptone 0·1 per cent. increased the percentage of damaged fibres after 48 days from 5 in the untreated control to 23. Peptone 0·1 per cent. together with K_2HPO_4 0·1 per cent. increased the decomposition after 42 days from 1 to 44 per cent. Potassium hydrogen phosphate 0·1 per cent. and sodium nitrate 0·1 per cent. produced only a slight increase in the amount of decay. The fact that organic nitrogen increases the rate of decay is of interest since, under ordinary storage conditions, it is practically impossible to prevent contamination with traces of this and other food substances.

The results of a determination of the nitrogen content of Indo-American and pure Indian varieties showed it to be slightly lower in the former than in the latter (0·111 and 0·123 in two samples of Cawnpore-American as compared with 0·215 and 0·244 in two pure Indian samples), but not sufficiently to justify the conclusion that resistance is due to an absence of nitrogen in the fibres.

A comparison of the rate of decay in English flax exposed to conditions similar to those used for the cotton showed that after dew retting the percentage of decomposed fibres in 37 days was 7, and after tank retting 21.

Jute and hemp were found to be unsuitable objects for study by the means outlined above owing to the closeness with which the individual fibres are interwoven.

Reynolds (E. S.). **Some relations of Fusarium lini and potassium cyanide.**—*Amer. Journ. of Botany*, xi, 4, pp. 215–217, 1924.

Experiments were conducted to test the toxic effects of potassium cyanide on *Fusarium lini*, the pathogen of flax wilt, and to determine any possible stimulation of growth of the fungus caused by this substance.

Synthetic agar media, to which were added varying strengths of potassium cyanide as indicated below, were inoculated with *F. lini* in the centre of each dish. A volume-molecular solution of KCN was made and diluted to the following strengths in the culture medium:—1/1,000 M; 5/1,000 M; 1/100 M; 2/100 M; 3/100 M: and so forth to 1/10 M.

The growth of the fungus was found to be depressed roughly in proportion to the concentration of the KCN. None of the cultures containing the cyanide reached more than about 95 per cent. of the

amount of growth made by the controls, and they gave as little as 31·6 per cent. when incubated for only 46 hours at the highest concentration permitting growth (0·02 M). On the other hand, the total growth of the fungus at the end of 151 hours was 261·1 per cent. of the growth made during the first 46 hours, when no cyanide was present, and 533·3 per cent. with 0·02 M cyanide. Further analysis showed that growth increased at the rate of 1·13 per cent. each hour between 46 and 151 hours in the cyanide cultures, while there was only a very slight increase in the controls. The greatest rate of growth in the whole series was in the 0·02 M concentration of KCN during the last stages of growth (125th to 151st hour).

It appears highly probable that the rapid increase in growth of the KCN cultures after the first slow period is due to a stimulative effect of the cyanide. The fungus, which is at first injured by the latter, later becomes not only accustomed to, but even benefited by it, at least in vegetative growth. KCN concentrations of 0·03 M and above entirely prevented the development of *F. lini* under the conditions of the experiment.

These results are of interest in view of the fact that young flax contains a glucoside, linamarin, which splits into hydrocyanic acid and glucose, and that certain moulds are known to be capable of splitting cyanogenetic glucosides.

McKerral (A.). **A note on Fusarium wilt of Gram in Burma and measures taken to combat it.**—*Agric. Journ. India*, xviii, 6, pp. 608–613, 1 pl., 1923.

After a reference to the economic importance of gram (*Cicer arietinum*) in Burma, the author states that in some parts of the country this crop is severely attacked by wilt caused by a *Fusarium* closely allied to the fungus [*F. udum*] attacking *Cajanus indicus* in India, and that the only hope of controlling the disease lies in the use of resistant varieties.

Of a large number of types of gram tested for yield during several years at the Padu Agricultural Station in the Sagaing district, the best results up to 1918 were obtained with a variety of black gram which was found to be more resistant than the usual Burmese type; it did not, however, generally find favour with buyers in Burma and its resistance to the disease was not maintained. In 1921, yield tests were arranged, both at Padu and Mandalay, between the Burmese types and a selection from a variety known as Karachi, which showed the latter strain to be satisfactory both commercially and from the point of view of resistance to wilt. In addition, all the 25 types described in *Memoirs Dept. Agric. India, Bot. Ser.*, vii, 6, 1915, were tested at Padu in 1922 and 1923; of these types, Nos. 1 to 9 were completely destroyed by the fungus, Nos. 10, 14, 16, and 24 were attacked but not completely destroyed, while the rest appeared to be resistant. With the exception of No. 2, however, they seem to be too late for Burma. As the Karachi variety was found to be much superior to the Burmese type, it was decided to replace the whole of the latter by the former in those localities at least where the disease is known to be prevalent, and returns made

independently by the Land Records Department showed the area under the new variety as 28,000 acres in 1923. The initial progress has thus been satisfactory, and a vigorous policy will be pursued with a view to eliminating the Burmese variety from all localities where the least signs of disease are seen.

PEAIRS (L. M.) & SHERWOOD (E. C.). **Orchard spraying.**—*West Virginia Agric. Exper. Stat. Circ.*, 36, 20 pp., 1924.

The chief fungous diseases of fruit occurring in West Virginia are briefly described with recommendations for control.

Spongy or *Volutella* dry rot [*V. fructi*] caused severe damage on Northwestern apples for the first time in 1923. The disease resembles bitter rot [*Glomerella cingulata*], but is distinguishable by the coal-black colour of the spots.

Directions are given for the preparation and application of the standard fungicides, with separate schedules for apples, peaches, and plums and cherries.

CURTIS (Miss K. M.). **Black-spot of Apple and Pear.**—*New Zealand Journ. of Agric.*, xxviii, 1, pp. 21–28, 3 diag., 1924.

Experiments are described in possible methods of reducing infection from black spot [scab] of apple [*Venturia inaequalis*] and of pear [*V. pirina*], both of which are definitely known to overwinter in New Zealand in dead fallen leaves [see this *Review*, ii, pp. 121, 122].

The first test, to ascertain the importance of ascospores from dead leaves in producing initial spring infections, was carried out on two 6-acre blocks in an orchard containing six varieties of apple. In the experimental block the leaves were raked and ploughed under by the beginning of August, while in the control they were left lying on the ground. Both the experimental and the control blocks were sprayed with lime-sulphur. The minimum reduction in infection in the experimental block by the removal of the leaves containing the ascospores was one-half; while in a group of Sturmers the ratio of diseased twigs in the control to that in the treated block was 6 : 1. The control of the fungus in the leaves, therefore, is a phase of scab control which cannot be overlooked.

Another test was carried out to determine the relative values of burning and burying the leaves for the prevention of ascospore infection. The least amount of twig infection occurred in the block in which the leaves had been burnt. It was found, however, that the process of raking the leaves from the trees and burning them occupied too much time, and it thus became necessary to seek another method of control.

The results of a third experiment to test the value of spraying the dead leaves for the prevention of infection by ascospores from them showed that definite control could be secured by this means. Except after abnormally wet weather the dead leaf spray need be given only when the normal applications are being made, a little extra time being devoted to a thorough coating of the fallen leaves. In New Zealand the critical time in an average year extends roughly from the beginning of the last week in September to the end of the first week in October. In cases of delayed rainfall,

however, the application of the spray should be postponed, since its maximum efficacy is ensured only when given immediately after rain.

GARDNER (M. W.). **Apple blotch in Indiana.**—*Hoosier Horticulture*, vi, 1, pp. 1–11, 1924.

In addition to an account of the symptoms, life-history, distribution, and control of apple blotch (*Phyllosticta solitaria*) [see this *Review*, iii, pp. 275, 276], particulars are given of the temperature relations of the causal organism.

Laboratory tests showed that in culture *P. solitaria* grows best at 75° to 80° F., considerable development, however, occurring at 61° and a slight amount at 54°. Spore germination in water occurred most readily at 75° to 80°, but was quite considerable also at 68° and 61°. Cankers incubated under moist conditions exhibited spore extrusion in sticky masses after a few hours at temperatures between 61° and 80°, most abundantly at 69°. After a longer period extrusion occurred also at 54°. Judging by these results, rather high temperatures are more favourable, but not essential, to the growth of the fungus.

The inhibition of the disease in northern latitudes is believed to be due, at any rate partially, to the shorter period of the year favourable to mycelial growth.

CUNNINGHAM (G. H.). **Fabraea scald, Fabraea maculata (Lév.) Atk. A fungous disease of the Pear and Quince.**—*New Zealand Journ. of Agric.*, xxviii, 2, pp. 96–102, 4 figs., 1924.

Fabraea maculata, which is widely distributed throughout Europe, North America, and Australia, is found in New Zealand only on the pear and quince.

Leaves, shoots, and fruit are attacked, partial defoliation, death of the laterals, and discoloration and cracking of the fruit resulting in severe cases. Nursery stock is frequently so badly affected as to be rendered unsaleable. Quinces are more severely attacked in New Zealand than pears, the leaves of which are seldom affected.

The symptoms of the disease and the life-history of the causal organism are described. Besides the spots on the leaf blades, small cankers are sometimes formed on the petioles; when these occur the leaves are killed outright. On laterals small, elliptical, somewhat sunken, dark brown spots are formed. On pear fruits the spots are at first small, circular, and of a rich carmine colour, gradually turning black in the centre and resembling those caused by *Venturia pirina*; the surface of the fruit becomes blistered and fissured. On quince fruits the spots are dark brown or black, often zonate, and ½ in. or more in diameter, occurring singly or in large, irregular areas.

In New Zealand, the occurrence of the saprophytic ascigerous stage appears, from the author's observations, to be very rare, and overwintering is thought to take place by means of perennial mycelium in infected twigs, though conclusive evidence to this effect is wanting.

In addition to the usual sanitary measures, the application of the

sprays recommended for the control of *V. pirina* [see this *Review*, ii, p. 121] is advocated.

FISHER (D. F.) & BROOKS (C.). **Control of brown-rot of Prunes and Cherries in the Pacific Northwest.**—*U.S. Dept of Agric. Farmers' Bull.* 1410, 12 pp., 9 figs., 5 graphs, 1924.

Brown rot (*Sclerotinia cinerea*) occurs annually on prunes and sweet cherries in the lower Columbia and Willamette Valleys, but it is only during abnormally wet seasons that its ravages are severe enough to attract general attention. Blossom infection in particular is frequently overlooked, but in severe cases from one-third to two-thirds of the blossoms may be destroyed. The fruit is most susceptible as it approaches maturity, and, if damp conditions prevail at harvest time, a third of the crop may be lost.

The life-history of the fungus is briefly described, with special reference to the production of apothecia, which are stated to occur in much greater profusion on moist, low-lying ground than on well-drained hills or coarse clay soils. Ploughing and harrowing are of great value in the control of brown rot, since deeply buried fruit is not likely to produce apothecia. In neglected orchards apothecial clusters have been found to occur to the extent of three or more per square foot.

The results of spraying experiments carried out from 1915 to 1919 in Washington and Oregon showed that complete control was ensured by the following spraying programme. (1) Bud spray: Bordeaux mixture 4–4–50 or lime-sulphur 1 in 50. (2) Calyx spray: the same as (1). (3) When husks are shed: self-boiled lime-sulphur 8–8–50 for prunes, lime-sulphur 1 in 50 for cherries. (4) Two to three weeks before maturity: the same as (3). All applications are important, the last being particularly valuable on prunes. A spreader should be combined with the fungicides, especially in the two last applications. Resin fish-oil cannot be used with lime-sulphur. Sulphur dust gave approximately as good control of brown rot as the standard spray materials (directions for the preparation of which are given), and may be substituted for them in all applications if desired.

YOUNG (P. A.). **Red Plum curl (caused by Exoascus mirabilis Atk.).**—Abs. in *Phytopath.*, xiv, 2, pp. 126, 1924.

A disease of red plums was noted in southern Illinois in 1920, 1922, and 1923, ½ to 5 per cent. of the twigs on infected trees being killed. The causal fungus has been identified as *Exoascus mirabilis*, which in macroscopic characters resembles *E. decipiens*. Infected leaves are greatly thickened and mostly unexpanded, merging imperceptibly into hypertrophied twigs, which, green at first, later dry up and become grey or black.

SMOLAK (J.). **K letošni puchrovilosti švestek.** [On this year's Plum rot.]—*Ochrana Rostlin.* iii, 3–4, p. 32, 1923.

In 1923 a very large portion of the crop of plums was practically wiped out in many localities of Bohemia owing to an exceptionally heavy outbreak of *Exoascus pruni*, following a cold and rainy spring. As control measures it is recommended to prune

off all cankered twigs and to spray with lime-sulphur before the opening of the flowers and after the fall of the petals.

SAVASTANO (L.). **Delle epidemie italiane del mal secco negli Agrumeti, Albicoccheti, Ficheti, Noceti e Gelseti. Studio di clinica arborea.** [On the Italian epidemics of blight in Citrus, Apricot, Fig, Walnut, and Mulberry plantations. A study in tree pathology.]—*Ann. R. Staz. Sperim. di Agrumic. e Fruttic. Acireale*, vii, pp. 89–176, 6 pl., 4 figs., 1923. [Received 1924.]

The trees forming the subject of the present study, viz. citrus, apricot, fig, walnut, and mulberry, are attacked by four allied diseases which are attributed to bacteria, namely, wilt (' mal secco '), gummosis [the author prefers the older term ' mal di gomma '], foot rot, and root rot. Their symptoms are described and means of distinguishing them indicated, as they frequently occur side by side on the one host. Wilt is characterized by the sudden drying up, in the spring or summer, of the new growth; similar symptoms may be induced by a number of agencies, biological and parasitic, which are enumerated. Root rot, which may be either partial or total, induces chlorosis and leaf fall, followed by the drying up of the branches. In partial attacks the symptoms may be confused with those of wilt, but they are less marked, and an incision in the still growing part of the branch will disclose sound tissues. Gumming, by blocking the vessels, may cause symptoms resembling wilt, and the same holds good for foot rot.

The different hosts are separately considered in their relation to this group of bacterial diseases, and the literature concerning them is traced from very early times. In dealing with citrus trees the author states that, in his experience, mal secco is the potential cause of more severe epidemics than the other three diseases. The causal organism in this case is *Pseudomonas citriputeale* [see this *Review*, ii, p. 392], the mode of infection by which is stated to be unknown, though insect transmission is suspected. All citrus varieties are subject, though in differing degree, to the disease, the susceptibility being greatest in the lemon and passing in a descending scale through sweet orange and tangerine, to the bitter orange, which in some regions is still immune. Trees grown from seed are less susceptible than those on stocks, and susceptible varieties grafted on bitter orange show increased resistance. The progress of the causal organism through the host is stated to be from the flower, through twigs, secondary and primary branches, and the trunk, to the roots, which it rots. The organism also produces another form of mal secco characterized by gummy stains on the branches, which appear to remain localized. The fruit is also attacked, with the production of blackish stains which spread up to a certain point, when the fruit falls off. The leaves are invaded chiefly in the summer, when they are covered at the tips and edges with dark spots, the centre of which dries up rapidly. The organism passes chiefly through the veins, which it blackens. In surface infections on the stem it advances from the cortex inwards, and the desiccation of the latter produces a flattening of the twigs and branches, which is not so noticeable in the trunk. The general

progress of the disease occurs in two directions, a rapid spread downward, and a slower one radially. In view of the impossibility of prevention, the only cure is to cut back diseased branches as soon as they are discovered. Spraying with lime-sulphur appears to have checked the disease in some cases but requires further testing. Proper cultivation, which increases the vigour of the trees, also increases their powers of resistance.

The mal secco of apricot trees is caused by *Bacillus amylovorus*, and the progress of the disease is similar to that in citrus trees, with this difference that in the apricot, as in the other hosts of the organism, it acts on the tissues at a certain distance in advance of its growth. To check the trouble, an early cutting back of the affected branches is necessary, as more thorough-going pruning at a later stage of the disease weakens the tree unduly. Of the other three diseases, gummosis is the most frequent, and trees affected with both troubles die off very rapidly. Root rot is less common, while foot rot has not been found by the author. Resistant varieties in the Vesuvian district are Monaca, Civica, Cerasella, Tracinella, and Abate.

Fig trees are subject to the same group of four diseases, though mal di gomma is represented by a canker of the trunk, which has so far occurred only sporadically. Root rot is responsible for local epidemics in water-logged soils, while foot rot is also limited in extent and virulence. On the other hand, mal secco has caused real epidemics in the Lecce, Calabria, and Salerno districts, and in the Province of Palermo, where one variety is intensively grown for the dried fruit industry. The symptoms, which do not differ materially from those described above, are given in detail, and the progress of the causal organism, which, according to Petri, is *Bacterium fici*, traced. In the fig the development of the disease is comparatively rapid, and its spread is probably effected by insects. Cutting back infected branches at the earliest possible moment, though uncertain in its results, appears to be the only known remedy. It is suggested that grafting on stocks raised from seed might give resistant trees.

The same four types of disease are stated to occur on walnuts, an additional symptom resulting from the blackening of the sap, either on contact with the air or as a result of the action of the pathogen, a feature from which the popular name of 'mal nero' or 'nerume' is derived. In the mal secco type, the disease may be either slow (3 to 5 years) in robust and adult trees, or rapid (a few months) in young trees. If infection occurs at the base of an internode, the organism—*Bacterium juglandis*—advances upwards, if at the top, progress is downwards. The woody nodes slow down the course of the infection if the attack is severe, and arrest it altogether, if weak. The slow development of the disease in the Sorrento region is due to the practice of annual pruning. In some cases of foot rot, a disease which in this host and in the fig is closely similar to citrus foot rot, and like the latter, not fully understood, the author obtained good results by cutting away all diseased wood and cauterizing and dressing the wound, but the treatment was unsuccessful in cases where the disease had reached an advanced stage. The author's experiments with *Jug-*

lans nigra as a stock (which is resistant) have given satisfactory results.

In mulberry plantations the mal secco, or 'falchetto', which is due to *Bacillus cubonianus* Peglion (*Bacterium mori* Boyer & Lambert), is widespread in Italy, and has caused severe losses in the High Milanese, in the Trentino, and in the environs of Ala. The stripping off of leaves and tender twigs for sericulture is a practice which exposes the mulberry more than other trees to bacterial infection. The author advocates moderation in this direction, while recommending that all infected branches should be pruned off at an early stage.

In conclusion the author states that diseases of the mal secco type are found in almost all cultivated trees, besides those mentioned. They differ from fungous invasions in being slower and by invading finally every part of the plant. Preventive measures are impossible (spraying experiments in America have given little or no result), and the diseases can only be coped with at a very early stage of attack, the detection of which needs constant supervision. The precautions to be taken are recapitulated, and the paper closes with a copious list of references.

BLACKMAN (V. H.) & JONES (G. H.). **Report on Gooseberry diseases in East Sussex, 1922–1923.**—12 pp., Hastings and Lewes, F. J. Parsons, Ltd., 1923. [Received 1924.]

A diseased condition of the gooseberries (mostly of the Leveller variety) grown for dessert in East Sussex has been under observation since 1921, *Armillaria mellea* and *Botrytis cinerea* having been found associated with cases of disease in that year and 1922 respectively.

During 1923 two distinct types of attack were observed, one a gradual and progressive die-back, and the other characterized by complete and sudden wilting. The damage caused by both forms of disease was variously estimated in different localities at from 5 to 50 per cent. There appears to be no direct connexion between the incidence of disease and such factors as soil, situation, and the like, except that defective drainage was observed to exercise very adverse effects on the health of the bushes.

The following fungi were isolated from the aerial parts of dead or moribund bushes: *Botrytis cinerea, Nectria cinnabarina,* and *Diaporthe strumella.* From the roots of dead bushes *Armillaria mellea* was obtained. Wilted or dead stems showing no external symptoms of fungi gave *B. cinerea*, a species of *Fusarium* which coloured nutrient substrata red, other species of *Fusarium*, *Phoma* sp., *Cytosporina ribis*, (?) *Eidamia*, and several unidentified organisms.

B. cinerea was isolated from the great majority of diseased specimens, and there is stated to be no doubt that it causes a large proportion of the East Sussex disease. One inoculation experiment with this organism gave positive results.

N. cinnabarina (in the *Tubercularia* stage) was prevalent in two plantations, the perithecial stage occurring on material in the rubbish heap. No other pathogenic organism was found in that

particular locality, and the *Nectria* was therefore held responsible for the disease.

A. mellea is stated to be causing serious and increasing damage in one plantation on badly drained ground. No sporophores have hitherto been found.

C. ribis, probably a weak and sporadic parasite, was once isolated, together with a species of *Fusarium*, from the dead limb of a forked branch whose other limb was healthy.

D. strumella, though not definitely proved to be pathogenic, should be regarded with suspicion in view of the virulence of *D. perniciosa* on apples.

For practical purposes all the diseases of gooseberries in the affected area may be divided into two groups: (1) Root disease due to *A. mellea*, causing complete wilting. Infected bushes should be eradicated and burnt, lime mixed with the soil in the hole, and the ground left fallow for at least a year. In cases of large affected areas a trench must be dug round the site of the eradicated bushes and a small quantity of lime placed in it. (2) Stem diseases due to one or more of the above-mentioned organisms. Local wilting is frequently the only symptom of disease, though occasionally the pustules of *Botrytis* or coral spots of *Nectria* may be seen on the stems. In the case of *B. cinerea* the edges of the leaves may show an ashen colour. The excision and pruning of dead wood should generally suffice to control this type of disease, but if *Botrytis* pustules are noticed in late winter an application of copper sulphate (4 lb. in 100 galls. water) should be given just before the buds break. In the event of a severe attack of *B. cinerea* after the bursting of the leaves a spray of Bordeaux mixture 8–8–100 is recommended. The Leveller variety is, however, stated to be particularly susceptible to foliage injury from sprays.

General sanitation and careful cultivation should do much to maintain the trees in a vigorous condition, thereby enabling them to resist the attacks of the weak parasites involved. Periodical applications of potash and lime, to balance the large quantities of nitrogenous manure used locally, are also advocated.

STEVENS (N. E.). **Notes on Cranberry fungi in Massachusetts.**—*Phytopath.*, xiv, 2, pp. 101–107, 1924.

Rots of cranberries (*Vaccinium macrocarpum*) due to various fungi, show, with one or two exceptions, no characteristic differences. Fungi belonging to 25 genera have been isolated from cranberries; several only once or twice, others much more frequently. Out of 5,412 cultures from decayed berries, *Fusicoccum putrefaciens* was isolated 2,209 times, *Glomerella cingulata vaccinii* 1,323, *Phomopsis* sp. 762, and 7 other fungi from 312 down to 15 times. The same fungi were also isolated from green berries but with different frequency. In tests on the effect of storage temperatures on the development of the different fungi, the growth of *F. putrefaciens* was found not to be inhibited near 0° C., while that of certain other common rot fungi was practically stopped. The difference in the temperature relations of the various rot fungi, however, does not explain their tendency to develop at different

times in storage (*F. putrefaciens*, for instance, being most abundant late in the storage season), a tendency which is all the more difficult to account for since the rot-producing fungi are actually in or on a large portion of the berries early in the season.

By cutting sterilized berries in half and culturing the halves separately, it was found that the blossom end of the berry is much more likely to be infected than the stem end.

The injury to cranberry buds and blossoms which has occasionally occurred in Massachusetts during the June floods was investigated, and it was found that fungi play little if any part in the so-called 'water injury'. That flood water acts as a carrier of fungous spores, however, was indicated by cultures from cranberry tips, which, in 1922 and 1923, yielded 35 and 14 per cent. respectively infected before flooding and 67 and 77 per cent. after.

Whilst the data presented were obtained in Massachusetts, the fungi are widely distributed in the United States, some details of the range of each being given.

BIRMINGHAM (W. A.). **Sclerotinia rot of Passion Vine.**—*Agric. Gaz. New South Wales*, xxxv, 1, pp. 57–58, 1924.

A rot of the passion-fruit [*Passiflora edulis*] caused by *Sclerotinia* sp. is described. It appears as a white mould on the surface of the stem; then the bark rots and falls away, exposing the wood. Flat, irregularly-shaped sclerotia are formed between the decayed bark and the wood, and the portion of stem below the point of attack often shows pronounced swelling. Affected plants turn yellow and wilt. Sclerotia are often found in the central cavities of the branches, where they assume the narrow, cylindrical form of the space in which they are confined.

Entry is usually gained through injuries brought about by tools used in cultivation, while lack of drainage predisposes the plant to attack. Diseased plants should be carefully removed and burnt, and an application of freshly slaked lime to the soil is recommended.

DARNELL-SMITH (G. P.). **'Bunchy top' disease in Bananas.**—*Queensland Agric. Journ.*, xxi, 3, pp. 169–179, 1 diag., 1924.

The results of recent field observations on bunchy top of bananas [see this *Review*, iii, pp. 384, 385] have shown that the first constant and apparently infallible symptom of the disease is the development of one or more dark green streaks, an inch or less in length, on the under side of the midrib of one of the younger leaves. In some cases this is followed by more streaks of varying length. Later on the outer leaves show a number of parallel green streaks in a similar position but at the point of attachment to the pseudostem. The development of the young leaves is arrested and they fail to spread normally, assuming a position more or less rectangular to the incident light but inclined upwards; with the emergence of successive leaves the apex of the pseudostem appears to become constricted and the leaves to bunch together. The laminae and midribs of the leaves become extremely brittle, and many of the leaves are often markedly ridged. The development

of the central leaf is also abnormal, the protective cap covering the apex falling away prematurely; the leaf expands slowly and water collects in the funnel formed by its partial unfolding. Putrefactive bacteria sometimes convert this stagnant water into a decaying mass. In other cases the constriction and cessation of growth at the apex of the stem prevent the development of the young leaves, the tissues of which are found to be compressed and distorted. On splitting open the pseudostem, scattered, gummy, brown areas, about a quarter of an inch in diameter, are found in the leaf sheaths. No bacteria were detected in these areas. The bunches of fruit may fail, partially or entirely, to pass the constriction at the apex of the pseudostem. The fruit is short, brittle, and sweet. The bracts subtending the male flowers are tipped with green, instead of being uniformly dark red as in normal plants, and curl backwards to a marked extent. Even apparently healthy suckers from diseased plants invariably develop the disease when planted out.

Healthy banana tissue is almost white when first cut open, a purplish colour rapidly spreading over the surface if a steel knife be used. In bunchy top corms this colour develops much more slowly. Corms in the incipient stages of the disease show small, irregularly distributed, yellow ducts following the course of the vascular bundles; each bundle usually has two, one on each side. These may extend as far upwards as the leaves. Their number increases with the progress of the disease, their colour changes from yellow to red, brown, and finally black, their contents solidify, and they may assume a moniliform appearance.

In advanced stages of the disease all the roots are found to be dead to within three inches of the corm. The xylem vessels are often brown, the cortex of the roots contains brown patches, and a variety of organisms, including species of *Fusarium*, are found in the decayed tissues. Diseased roots frequently have greyish tips and grey to purple laterals, on which are bright blue patches of epidermal cells. The root hairs are frequently open at the ends and full of organisms resembling micrococci. Zoogloeal masses of a brilliant blue may also occur on the surface of the roots.

Various observations, including a comparison between the behaviour of healthy and diseased corms kept under identical conditions, have convinced the author that the cause of bunchy top must be sought in the roots of the corms. Roots from diseased corms develop slowly and turn grey with blue patches, instead of remaining white as in healthy corms. Apparently healthy suckers frequently develop bunchy top when planted. If these are removed and fresh corms planted, the latter also develop the disease. Infection spreads from the first cases to the plants immediately adjoining, but a diseased plant was kept for a year in a pot without infecting six healthy plants near it. These observations suggest fungous or bacterial infection of the root or corm by a soil organism capable either of parasitic or saprophytic existence. This would accord well with the sporadic nature of the disease.

The sap of affected bananas is light red instead of yellow in colour, settling on the corm to a dark brown solid. It is believed that the suspected soil organism causing the disease secretes a toxin

which affects the sap and eventually promotes the development of bunchy top.

The suggested association of aphids with the disease has not been established, but observations on this point are being continued. There is a good deal of evidence already that aphids do not readily carry the infection.

A detailed account is given of the various forms of treatment applied to bunchy top areas in the hope of effecting a cure. None of these has so far produced the desired results. The author is of opinion that affected plants are almost incapable of responding to manurial treatment.

Bunchy top is known to occur in Ceylon and Fiji. In the latter islands reports of an early outbreak of a disease, which the author has little doubt was bunchy top, date back to 1879.

Two reputedly immune varieties, the Hansonian and the Vernon, are being tested in the Tweed district, where the Cavendish (the variety chiefly grown), Ladies' Fingers, Gros Michel, and a Moa banana are susceptible.

ZELLER (S. M.). **Mosaic disease of Loganberry.**—Abs. in *Phytopath.*, xiv, 2, p. 119, 1924.

Loganberry mosaic, which is very destructive and widespread in the United States, occurs frequently in Oregon, where many 1- to 60- acre tracts have been grubbed out because of the disease and nearly all the young plantings have from 3 to 95 per cent. infection. Plants die in 3 to 4 years after the first symptoms appear.

GRUBB (N. H.). **Tests of fungicides on Apple trees. II. An analytical study of their effects on the trees.**—*Journ. Pomol. and Hort. Science,* iii, 4, pp. 157–173, 1924.

The author's earlier investigations at the East Malling Research Station [see this *Review*, i, p. 27] have been continued, the present paper embodying the results obtained from 1919 to 1922.

All the fungicides used throughout the tests [details of which are given] reduced the attacks of scab (*Venturia inaequalis*), Bordeaux mixture 6–20–100 controlling the disease almost as effectively as lime-sulphur 1 to 59 and more so than ammonium polysulphide. Bordeaux mixture was the least efficacious preparation against mildew (*Podosphaera leucotricha*), lime-sulphur proving somewhat superior to ammonium polysulphide. The fungicides used in 1920 clearly reduced the number of canker (*Nectria ditissima* [*N. galligena*]) infections of Worcester Pearmain and James Grieve in the following winter.

Bordeaux mixture 6–20–100 caused severe russeting of the fruit of Lord Derby and produced considerable injury also on the James Grieve and Newton Wonder varieties.

Used as a summer fungicide, lime-sulphur repeatedly caused a heavy fruit drop from trees of all the varieties tested, especially when leader-tipped.

The effect of the fungicides in the reduction of scabbed fruit was found to extend one or two (and in one case three) years from the season of application.

Conflicting evidence was obtained from tests of the influence of fungicides on the size of the fruit. Vigour of growth, however, as measured by weight of prunings, appears to have been almost uniformly increased by spraying. This cannot be explained solely on the basis of the heavy fruit drop caused by lime-sulphur, since the phenomenon was also observed to follow the application of Bordeaux mixture.

The increased formation of fruit buds noticed in certain cases is believed to be possibly only a natural sequence of the drop caused by lime-sulphur.

ROBINSON (R. H.). **The preparation of spray materials.**—*Oregon Agric. Exper. Stat. Bull.* 201, 14 pp., 1 fig., 1924.

Full directions are given for the preparation of lime-sulphur, including self-boiled, dry-mix [see this *Review*, ii, p. 506], and Oregon cold-mix, which consists of 8 lb. sulphur, 4 lb. hydrated lime, and 2 qts. skim milk; other sulphur sprays, including soluble sulphur and dry lime-sulphur, which consists of 70 per cent. calcium polysulphide, 5 per cent. calcium thiosulphate, 10 per cent. free sulphur, and 15 per cent. inert ingredients; Bordeaux and Burgundy mixtures; and various insecticides.

Advice is given on the combination of sprays, the selection of materials, and the like.

BECKERICH (A.). **Les bouillies sulfocalciques dans la défense des vignobles et des vergers en 1923.** [Lime-sulphur mixtures in the defence of vineyards and orchards in 1923.]—*Rev. Vitic.*, lx, 1544, pp. 89–95, 1924.

The author describes experiments carried out in different localities with the proprietary lime-sulphur preparation known as 'Paratol', and quotes reports from a number of users, according to which not only insect pests and fungous diseases were kept in check but the plants treated grew more vigorously and produced better fruit in consequence. The four treatments commonly in use for fruit trees, namely, at the opening of the buds, immediately after flowering when the fruits begin to form, at the end of June, and at the end of August, are stated to give adequate protection. The fruit trees experimented with include peach, pear, apple, and cherry.

For the vine the following treatment is advocated. A first application at a strength of 4 kg. to 100 litres water before the opening of the buds, taking care to reach the under part of the old bark where insects shelter; a second application from 25th April to 1st May, when the shoots are 10 to 15 cm. long, at a strength of 1 kg. to 100 litres; a third before flowering at the same strength; a fourth immediately after flowering, also at the same strength; and a fifth at a strength of 2 kg. to 100 litres between 1st and 10th July (against *Cochylis* and *Eudemis*). In case of attacks by mildew [*Plasmopara viticola*] or *Oidium* [*Uncinula necator*] an immediate application at a strength of 2 kg. to 100 litres is recommended. The results in treated vineyards are stated to have been generally satisfactory, both for preventive and curative purposes, especially in the case of *Oidium*.

SHOEMAKER (J. S.). **Lime sulphur injury.**—*Scient. Agric.*, iv. 6, pp. 180–184, 1924.

Injury from spraying with lime-sulphur has been ascribed to various factors, and the author surveys the literature on the various theories put forward to explain its action under the following heads: (*a*) the soluble polysulphides as the direct agents—the theory most in favour, but one that does not account for the injury which may take place when the soluble polysulphides are not active; (*b*) the absorption of the lime-sulphur by the chlorophyll; (*c*) sunlight; (*d*) heat; (*e*) gas; (*f*) acid; (*g*) oxidation; (*h*) minuteness of sulphur particles. Citations of the seventeen papers quoted are given.

Observations in past years have indicated that some of the factors conducive to chlorophyll destruction are conditions leading to a thin epidermis, reduction of pubescence, loose internal structure, presence of nascent oxygen, strong sunlight liberating actinic rays and heat and subsequent killing of the tissues.

Microscopic examination shows that the injury first appears on the underside of the leaf as a russeting. The injurious substance evidently enters through the stomata, as the browning begins at these openings.

The author reaches the conclusion that we are not yet in a position to select any one factor as the cause of lime-sulphur injury under all conditions. Sometimes the factors may act independently and sometimes in conjunction with one another.

SCHMIDT (E. W.). **Die fungizide Wirkung von Seifenlösungen.** [The fungicidal action of soap solutions.]—*Ber. deutsch. Bot. Gesellsch.*, xlii, 4, pp. 131–135, 1 fig., 1924.

Soft soap solutions are stated to have a well-known fungicidal value, especially in regard to parasites of the vine. The results of tests with *Botrytis cinerea*, *Monilia*, and *Fusicladium*, carried out by the author, showed that the fungicidal action was due to a definite degeneration of the fungal cells in contact with the soap which, though characterized by an increase in the fat content, was distinct from the 'fatty degeneration' which frequently develops in old cells.

When a 1 per cent. soft soap solution was dried on a glass slide, and spores of *Botrytis* sown in a drop of water were placed on it, the action was marked within 24 hours. Compared with the controls on a slide without soap, the spores in the solution were more swollen, darker, and filled with shining droplets giving the tests for fats. After 48 hours or more the fat drops merged into one or several large masses, occupying the entire spore. As a rule, germination was prevented. In soap solutions of 0·25 to 0·5 per cent. with the addition of 0·25 per cent. sugar germination occurred, but the germ-tubes, usually multiple, were thick, short, often swollen on one side or otherwise deformed, and of limited growth. They were closely packed with fat balls, which finally formed a single strand of fat in almost every cell. These conditions may gradually disappear if the spores are removed in time and sown in water or nutrient solutions. Recovery does not take place, however, after three or more days in the soap solution.

The effect of soap as described above is observed to some extent in solutions of 0·01 per cent. in water or 0·1 per cent. in prune juice. Tests with caustic potash showed that solutions of 0·1 and 0·5 per cent. KOH prevented germination but did not induce abnormal fat formation.

When sprayed on plants, the author suggests that the soap, if not completely hydrolysed in the solution, is hydrolytically split up by atmospheric moisture into oleic acid and KOH, which, even at low concentrations, impedes the development of spores such as those of *Botrytis*. From the oleic acid penetrating the cell arise small deposits of fat, which, in the first place, occupy the vacuoles and finally, as shown above, merge into large masses, rupturing the delicate protoplasm of the vacuolar membrane, and thereby gradually destroy the spores. Even when death does not result, the parasitic activity of the fungus is inhibited.

FERDINANDSEN (C.). **Kemiske Afsvampningsmidler.** [Chemical disinfectants for fungous diseases.]—*Ugeskr. for Landmaend*, lxix, 8, pp. 109–112, and 9, pp. 125–127, 1924.

The general principles of seed disinfection for the control of various cereal diseases are discussed and the properties, advantages, and disadvantages of the fungicides generally employed for the purpose described.

The cheapness of formaldehyde and copper sulphate and the high fungicidal efficiency of the former are important advantages over the other preparations, but are offset by the risk of seed injury. Kalimat, a mixture of formaldehyde and phenol, has not been sufficiently tested for comparison : it costs about twice as much as formaldehyde.

The tillantin preparations contain copper sulphate and arsenic. Tillantin B is used against purely surface contaminations such as bunt of wheat [*Tilletia tritici* and *T. levis*] and oat smut [*Ustilago avenae*]. Tillantin C is intended for the control of diseases carried in the seed coats such as stripe disease of barley [*Helminthosporium gramineum*] and the snow mould of rye [*Fusarium nivale*], and the writer's experience with it against the first-named has been extremely favourable, both as regards germination and fungicidal efficiency. Tillantin B was satisfactory in the former respect but not altogether so in the latter. The price of the tillantin preparations is stated to be somewhat below that of germisan.

Copper carbonate dust is efficacious only in the control of purely surface contaminations, and is rather expensive. On the whole, the results of Danish experiments confirm the favourable opinion of this compound generally held in America. The use of a rotatory drum is recommended.

Corrosive sublimate has given excellent results in the control of stripe disease and the snow fungus at a moderate cost, but the risks involved in the use of this poison are such as to disqualify it for general purposes.

Fusariol, a mixture of copper sulphate and corrosive sublimate, has proved valuable in the control of bunt and *F. nivale*, while giving less satisfactory results with stripe disease.

Uspulun (mercury chlorphenolate) is only on a par with copper sulphate as regards fungicidal efficacy in the control of stripe disease, but has given better results with purely surface contaminations, especially bunt. Its effect on germination is excellent, but it is a much less powerful fungicide (at any rate at the ordinary strength) than corrosive sublimate. Its present cost is stated to be somewhat higher than that of germisan.

Germisan is a disinfectant of the very highest quality both for surface contaminations and diseases carried in the seed coats. It is undoubtedly the best preparation yet discovered for the control of stripe disease, and has also given very good results in that of bunt and other diseases of the same type, though it hardly affords adequate protection against reinfection with bunt. The price of this preparation, however, is very high.

Höltzermann (F.). **Keimungs- und Wachstumsbeschleunigung durch Uspulun-Beize.** [The acceleration of germination and growth by disinfection with uspulun.]—*Deutsche landw. Presse*, li, 8, p. 79, 1 fig., 1 diag., 1924.

During the late summer of 1923 the writer instituted a series of experiments on the disinfection of rye seed with uspulun at Rusgi, Lithuania, in which country the use of such methods is stated to be almost unknown. The seed, which originated from a crop heavily infected with the snow fungus [*Fusarium nivale*], was immersed for two hours in a 0·25 per cent. solution of uspulun and sown on 15th September in plots of 100 sq. m. fertilized with 3 kg. of 18 per cent. superphosphate and 1·5 kg. of 40 per cent. potassium nitrate. Two plots were sown with untreated seed for control purposes. Within a week the difference between the treated and untreated plots was distinctly noticeable in the far more uniformly vigorous condition of the stand in the former.

On 19th September the test was repeated in boxes, the seed being sown in plots of three rows, each plot containing 100 grains in all. On the 23rd the average length of the plants was 31·9 and 30 mm. in the two treated plots as against 21·4 and 19·9 mm. in the untreated. The number of seeds which had germinated by the 29th was 76 per cent. in the two treated, as compared with 49 and 56 per cent. in the untreated plots.

Glasgow (H.) & Gloyer (W. O.). **Mercuric chloride as a preventive of damping-off fungi.**—*Science*, N.S., lix, 1528, p. 338, 1924.

For the last three years the results of experiments at the Geneva (New York) Agricultural Experiment Station have shown that two or three applications of corrosive sublimate 1 in 1200 (or even weaker) give excellent control of *Rhizoctonia* in cabbage seedbeds. The treatment is being tried on *Plasmodiophora* [*brassicae*] and on various other soil-infesting organisms on different crops, and it appears probable that the method may have a wide application.

ÅKERMAN (Å.). **Några erfarenheter rörande betning av årets havre-och vårveteutsäde.** [Some experiments in the disinfection of the current year's Oats and spring Wheat seed-grain.] —*Landtmannen*, vii, 15, pp. 276–277, 1924.

The results of investigations at the Svalöv Experiment Station showed that the germinative capacity of the current year's oats and wheat seed was greatly reduced by the attacks of *Fusarium*, and experiments were carried out to determine how far this condition could be remedied by treatment with uspulun, germisan, or copper sulphate. It was found in one test that spring wheat seed with an estimated germinative capacity of 6 per cent. normal and 34 per cent. weak plants, gave 77 per cent. normal and 2 per cent. weak after treatment with uspulun, the corresponding figures for germisan being 60 and 6 per cent. Copper sulphate, on the other hand, gave only 22 per cent. normal and 30 per cent. weak. Similar results were obtained in further tests with uspulun and germisan, germinative capacity and vigour being greatly enhanced both in wheat and oats. Neither copper sulphate nor formalin was satisfactory. Sprinkling the wheat was found to be quite as effective as immersion.

DARNELL-SMITH (G. P.). **Copper carbonate and the removal of bunt balls from seed Wheat.**—*Agric. Gaz. New South Wales*, xxxv, 1, pp. 11–12, 1924.

The question of removing bunt balls when wheat is to be treated with dry copper carbonate is discussed. The process of grading seed wheat, which is considered of the greatest importance, removes them almost entirely, if present, and any bunt balls remaining, or spores from burst balls adhering to the grains, will be killed by the copper carbonate treatment, not at the time of its application but at the time when the wheat actually begins to germinate in the soil.

SALMON (E. S.) & WORMALD (H.). **The prevention of 'bunt' in Wheat.**—*Journ. Min. Agric.*, xxx, 10, pp. 918–925, 1 fig., 1924.

In a previous paper [see this *Review*, ii, p. 308] the authors recommended the use of 1 part of formalin to 480 of water applied at the rate of 2 galls. to 4 bushels (1 sack) for the control of bunt [*Tilletia tritici* and *T. levis*]. They have now carried out experiments to ascertain whether a smaller quantity of the solution would suffice. It was found that to ensure good disinfection, the wheat must be sprinkled at the rate of 2 gallons to 4 bushels (giving 0·30 per cent. infection): 1·5 gallons still gave very fair results (1·25 per cent.); but 1 gall. was clearly insufficient, as grain so treated gave rise to 21·8 per cent. of bunted ears. The control gave 78·45 per cent. bunted.

A comparative field experiment was also made on the College Farm at Wye with two lots of Yeoman wheat respectively treated with the formalin solution (1 in 480, using 2 galls. per sack) and with copper sulphate (1 lb. to 1 gall., using 1 gall. per sack). The results showed that while no appreciable difference existed between

the two resulting crops from the point of view of infection and yield, the treatment with copper sulphate retarded the germination by 3 or 4 days and killed from 6 to 9 per cent. of the seeds.

In concluding, the authors repeat their instructions for the safe treatment of wheat with formalin, which they consider a certain preventive of bunt.

GRAM (E.). **De lokale Afsvampningsforsøg.** [Local disinfection experiments.]—*Ugeskr. for Landmaend*, lxix, 14, pp. 204–206, 1924.

The results of experiments in the control of stripe disease of barley [*Helminthosporium gramineum*] in different parts of Denmark in 1923 are summarized. In severe attacks germisan was found to give better control and larger yields than uspulun or copper sulphate. Both germisan and uspulun, unlike formalin, could safely be applied several weeks before sowing, so long as the seed was well dried after treatment.

MÜLLER (H. C.), MOLZ (E.), & MÜLLER (K.). **Ueber die Bekämpfung des Wurzelbrandes der Rüben durch Saatgutbeize.** [The control of root rot of Beets by seed disinfection.]—*Deutsche landw. Presse*, li, 7, p. 62, 2 figs., 1924.

The results of a five years' trial conducted at the Halle Phytopathological Experiment Station in the control of root rot of beet [see this *Review*, ii, p. 74] by seed disinfection are described, references to the work of previous investigators being given.

Corrosive sublimate (immersion for six hours in a 0·2 per cent. solution) gave satisfactory control of the disease but considerably impaired germination. A similar criticism is applicable to mercuric cyanide, except that 0·1 per cent. of this preparation was equal to 0·2 per cent. of corrosive sublimate.

Carbolic acid controlled the disease after 20 hours' immersion, but considerably reduced germination.

Concentrated sulphuric acid failed to eliminate infection and adversely affected germination. It is regarded as quite an unsuitable preparation for the control of root rot, and the same is still more the case with hydrochloric and nitric acids.

Uspulun stimulated germination and increased the yield from the treated plants, but did not absolutely control the disease.

Germisan (0·25 per cent. for two hours) generally delayed germination while increasing the ultimate vigour of the stand. Good control of root rot was secured, but in 1922 the yield was reduced as a result of the treatment.

Preparation 778 (betanal) (0·75 per cent., one to two hours) frequently (though not uniformly) accelerated germination, increased ultimate vigour, gave good control of root rot, and greatly augmented the yield in 1922 and 1923.

The hot water treatment accelerated germination and increased the vigour of the stand and amount of yield, but (in laboratory experiments) favoured the development of root rot.

Smith (J. H.). **The killing of Botrytis cinerea by heat, with a note on the determination of temperature coefficients.**—*Ann. of Appl. Biol.*, x, 3–4, pp. 335–347, 5 figs., 1923.

In determining the action of moist heat on the spores of *Botrytis cinerea*, essentially the same method was employed as that used for testing the effect of phenol [see this *Review*, i, p. 114]. Spores of the organism grown under the same conditions and for approximately the same time were dropped into distilled water at temperatures ranging from 31° to 50·3° C.; samples were then taken from time to time and the proportion of spores able to germinate on Czapek's agar at a temperature of 24–25° determined. The results were plotted for each temperature and gave a series of approximately symmetrical sigmoid curves, all exactly alike except for the change in the speed of killing. The curves were superimposable on adjustment of the time scale, and in this respect they differ from the curves obtained with phenol, where the shape changed as the strength of the poison increased and eventually became logarithmic. The shape of the general curve agrees excellently with a recognized type of frequency distribution (Student, *Biometrika*, vi, p. 1, 1908), and the observations at all the temperatures examined fall closely on the curve of this distribution. The effect of temperature on the velocity of the reaction is very considerable, and the relationship is expressed by the formula of Arrhenius for the velocity of chemical reactions with great exactness if the temperature is reckoned from 0° C. instead of the absolute temperature from −273° C. The whole of the killing process for any temperature within the limits studied under the conditions and with the strain of *B. cinerea* used may be completely expressed by combining the formula for the curve and the formula for the velocity-temperature relationship. It is pointed out that the influence of temperature on the rate of the process is more accurately represented by comparing the times required to reach a constant result than by comparing the results reached in a constant time, and that this is of somewhat general application in biological studies.

Costantin (J.). **Sur le Pleurote du Chardon bleu de la Vanoise.** [On the *Pleurotus* of *Eryngium alpinum* in the Vanoise [Savoy].]—*Comptes Rendus Acad. des Sciences*, clxxvii, 19, pp. 849–852, 1923.

In this note the author discusses the relationship of a form of *Pleurotus* closely resembling *P. eryngii* (which he regards as a new species or new variety and proposes to name *P. hadamardii*) to its host *Eryngium alpinum*. The striking feature in the development of the fungus is that the fructifications, as observed both in 1921 and 1923, appear in great numbers a week after the mowing of the Alpine meadows in which *E. alpinum* grows abundantly. In 1922 the fructifications failed to appear, probably owing to the early fall of snow at the beginning of September. The fungus is believed to be present in the host during the vegetative life of the latter, existing with it in a kind of symbiotic equilibrium which is broken down when the plant is cut. It then gains the upper hand, causing the decay of the stubble of the host (the root-stock of which is frequently found rotted in the centre by parasitic action) and

producing its fructifications in great numbers. Some observations lead the author to believe that the fungus is not restricted to *Eryngium alpinum* but may also parasitize other Umbelliferae such as *Laserpitium*.

COSTANTIN (J.). **Sur la récolte et la culture des Pleurotus d'Eryngium.** [On the gathering and the culture of the *Pleurotus* of *Eryngium*.]—*Comptes Rendus Acad. des Sciences*, clxxvii, 20, pp. 921–925, 1 fig., 1923.

The author states that *Pleurotus hadamardii* [see last abstract] is edible and preserves its good flavour and odour when dried, so that it might be worth exploiting. The host plant *Eryngium alpinum* is known to occur not only in the Alpine regions of Savoy, but also in the mountains of Dauphiné and Provence [France], of Switzerland, Italy, Croatia, &c., and by using it for the production of the fungus, waste tracts of land unsuitable for general agricultural purposes might be turned to advantage. He succeeded in isolating the mycelium of the organism and in cultivating it artificially on sterilized root-stocks of *Eryngium alpinum*, *E. campestre*, *Laserpitium latifolium*, and of other Umbelliferae. In one case he obtained an immature fructification the size of a walnut, but in nature the mature pileus is from 15 to 18 cm. in diameter.

SEVERIN (H. H. P.). **Curly leaf transmission experiments.**—*Phytopath.*, xiv, 2, pp. 80–93, 1 fig., 1924.

The author describes a series of experiments carried out to elucidate the transmission of curly leaf of [sugar] beets [see this *Review*, iii, p. 290].

By inoculating healthy beets with juice from the leaves and roots of infected beets, the symptoms of curly leaf were produced in 9 cases out of 100, the period of incubation varying from 12 to 39 days. Non-infected beet leafhoppers (*Eutettix tenella*), fed on the artificially infected beets, transmitted the disease to healthy beets, the symptoms appearing in from 2 to 13 days.

In field and laboratory experiments contact of healthy roots with infected ones failed to bring about the disease, which is not transmitted through the soil. The infective principle is generally distributed in the foliage and root.

The rate of movement of the infective principle in the petiole of the sugar beet was investigated and the maximum recorded spread was 7 inches in 30 minutes, the temperature being 103·5° F. By inoculating the outer leaves by means of infected leafhoppers and testing the infectivity of the younger leaves, it was found that it took a minimum of 2 days for the infective principle to travel from the oldest to the youngest leaves of beet seedlings and from 6 to 12 days of larger beets.

Infective beet leafhoppers were shown to retain their infectivity during all the nymphal stages and throughout the adult life.

Experiments to determine whether the beet leafhopper increases the virulence of *Bacillus morulans* isolated from curly leaf beets gave negative results.

CARSNER (E.) & STAHL (C. F.). **Progress report on curly-top of the Sugar Beet.**—Abs. in *Phytopath.*, xiv, 2, pp. 122–123, 1924.

Seed was grown from beet plants apparently resistant to curly top, and marked resistance has been noted in some of the progeny strains, the most promising of which, however, tend to produce seed stalks the first season.

One of the writers has reproduced the disease by inoculating with the expressed juice or small pieces of diseased tissue. This supports the work of Severin [see preceding abstract] and increases the evidence for classifying curly top as a mosaic disease.

In a few cases successful inoculations of *Chenopodium murale* were obtained and some indication was given that the virus may be attenuated or modified by passage through this resistant plant.

GRAM (E.). **Mosaiksyge i Drivhusene.** [Mosaic disease in greenhouses.]—Reprinted from *Gartner-Tidende*, 8 pp., 6 figs., 1 diag., 1924.

A popular account is given of the history, symptoms, distribution, mode of dissemination, and control of mosaic disease in Cucurbitaceae and Solanaceae (especially tomato), with a complete list of the cultivated and wild hosts at present known, and references to the investigations of Bewley and various American workers. A diagram showing the cross-inoculations that have been effected between the different hosts is included.

SMITH (K. M.). **On a curious effect of mosaic disease upon the cells of the Potato leaf.**—*Ann. of Botany*, xxxviii, 150, pp. 385–388, 4 figs., 1924.

During a critical investigation of the tissue of mosaic-infected potato leaves the almost constant presence was observed, in the leaf cells, of a number of peculiar amoeboid bodies, varying in size and shape but usually roughly piriform or roundish. These bodies, which stained well with Flemming's triple stain or Heidenhain's iron-haematoxylin, appeared to possess definite walls and had one or more clearly defined vacuoles. Negative results were obtained in attempts to cultivate them, and they failed to display any sign of life. No trace of a nucleus could be detected. The general disintegration of the tissue in the chlorotic areas to which these bodies are apparently confined is considerable. The chloroplasts are reduced in number, the cell walls ruptured, and the nuclei in a complete state of degeneration.

It appears probable that these and similar bodies associated with the virus diseases of plants [see this *Review*, ii, p. 241 *et passim*] are a degeneration product of the cell induced by the disease, being, therefore, effects rather than causes of the disturbance.

PEYRONEL (B.). **Prime ricerche sulle micorize endotrofiche e sulla micoflora radicicola normale delle fanerogame.** [Preliminary researches on the endotrophic mycorrhiza and on the normal fungous flora of the roots of phanerogams.]—*Riv. di*

Biol., v, 4, pp. 463–485, 11 figs., 1923, and vi, 1, pp. 17–53, 14 figs., 1924.

The author's researches on endotrophic mycorrhiza, most of which have already been noticed from earlier papers [see this *Review*, ii, p. 172, iii, p. 290] are described at some length and have led to the following conclusions.

The endophytes which, in most phanerogams provided with endotrophic mycorrhiza (except orchids), produce arbuscules and vesicles, are considered to be Phycomycetes belonging to a primitive group from which originated also the Mycomycetes. The genus *Endogone* is regarded as probably representing a stage in the life-cycle of the mycorrhizal endophytes.

The so-called vesicles of the phycomycetoid endophytes, which may in part serve as temporary stores of reserve food material or develop into oospores, very probably are destined in great part to become sporangia. These may remain quiescent for a long period, developing their spores only when the environmental conditions are such as to favour dissemination.

The mycelium of the phycomycetoid endophytes [the morphological characters of which are fully described] forms in humid soils a continuous network which involves the root system of the host plants, passing from one to another.

These phycomycetoid endophytes also lead a saprophytic existence, continuing their development in the cortical tissues of the roots after the death of the latter. In the soil itself they produce vesicles in large numbers, as well as lateral ramifications of the mycelium which may be regarded as homologous with the arbuscules.

The endophytes of the Orchidaceae have no affinity with those of the phycomycetoid type and no doubt belong to the Mycomycetes (probably Basidiomycetes).

The phycomycetoid endophytes in many plants frequently become covered by another endophyte of the orchid type, developing chiefly in the upper cortical layers and behaving more as a semiparasite or saprophyte than as a genuine symbiont. Its saprophytic development is even more profuse than that of the phycomycetoid endophytes, and it is readily cultivable on the usual artificial media.

In the root system of almost all the numerous plants examined were found, besides the mycorrhizal endophytes a certain number of saprophytic fungi belonging to various genera. *Asterocystis radicis* was also frequently encountered, both on healthy and decayed roots, and appears to be quite as constant an associate of nearly all the plants studied as the phycomycetoid endophytes and those of the *Rhizoctonia* type. It is very probable that, under unfavourable environmental conditions, these organisms inhabiting the root system can become virulent parasites.

The assertion that annual plants have no mycorrhiza, or only temporary ones [see this *Review*, i, p. 232], is not altogether correct. Summer wheat (*Triticum aestivum*), barley, maize, and rye, grown in suitable conditions, are constantly provided with mycorrhiza. On the other hand various perennial plants are completely devoid of them.

A bibliography of 66 titles is appended.

McLuckie (J.). **Studies in symbiosis. V. A contribution to the physiology of Gastrodia sesamoides (R. Br.).**—*Proc. Linn. Soc. New South Wales*, xlviii, 3, pp. 436–448, 16 figs., 1924.

Gastrodia sesamoides, a non-chlorophyllous, endemic, Australian orchid, has been erroneously regarded as a possible parasite on the roots of other plants. The results of the author's investigations described in the present paper have shown that it is not parasitic but a saprophyte living in an elaborate and remarkable symbiotic condition with a mycorrhizal fungus and a bacterium.

The fungus inhabits isolated patches of the superficial cells of the fleshy succulent rhizome, and hyphae penetrate outwards into the soil, establishing communication for a supply of the soil-constituents to the endophytic hyphae and to the orchid.

There are few roots developed and no root hairs. A few hairs are found on the rhizome, which is characterized by numerous annulations bearing colourless scaly leaves. From the apex of this rhizome, which is perennial and contains large quantities of starch, the flowering axis is developed as a slightly succulent brown shoot, up to 18 inches long, and with a few sheathing, membranous, scaly leaves. The fungous hyphae are not digested by the host cells and therefore have functions more like those of ectotrophic than endotrophic mycorrhiza. The fungus has coarse, thick-walled, non-septate hyphae, sometimes swollen at the ends into sporangiole-like bodies. In some of the infected cells numerous small, thick-walled, spiny spores occur, apparently formed by the fungus.

Bacteria occur in vast numbers in the living cells of the rhizomes; in some cases they are massed in threads passing from cell to cell, in others they occur as ovoid colonies or masses surrounded by a gelatinous matrix. They are frequently found massed in the vicinity of the nucleus or distributed densely throughout the cell. They enter the rhizome through the epidermal hairs or the epidermis itself, and occur in the roots and flowering shoot as well as in the rhizome. Tests showed that they are capable of fixing free atmospheric nitrogen: in 100 c.c. of a nitrogen-free culture solution, 7·8 mg. of N was assimilated in 15 days.

G. sesamoides is stated to be an elaborate example of symbiosis in which an angiosperm is associated with a fungus and a bacterium, and is directly or indirectly dependent on its endophytes for its carbonaceous and nitrogenous foods. The fungus is thought to provide water and ash constituents, replacing root hairs in this function, and also to provide carbon and possibly organic nitrogenous compounds from the soil. The bacterial activity is probably sufficient to supply most of the nitrogenous nutrition required. The author is inclined to regard the association as obligatory.

Melin (E.). **Experimentelle Untersuchungen über die Konstitution und Oekologie der Mykorrhizen von Pinus silvestris L. und Picea Abies (L.) Karst.** [Experimental investigations on the constitution and ecology of the mycorrhiza of *Pinus sylvestris* L. and *Picea abies* (L.) Karst.]—*Mykol. Untersuch. und Ber.* ii, pp. 73–330, 2 pl., 106 figs., 1923.

In this comprehensive survey of his observations, investigations,

and experiments on the mycorrhiza of *Pinus sylvestris* and *Picea abies,* most of which have already been noticed in this *Review* from other sources, the author presents his conclusions on the influence of ecological factors on their development. No support was found for the theory that the development for mycorrhiza is dependent on the vigour of the host, the fungi thriving equally well on sickly and on healthy roots, unless their virulence was previously diminished by growth on an unsuitable medium [see this *Review,* iii, p. 471]. In fact, the readiness or otherwise with which the fungi develop in the soil is stated to be the decisive factor in mycorrhizal formation.

The fungi concerned in the formation of mycorrhiza are described at considerable length. *Mycelium radicis sylvestris* α [see this *Review,* iii, p. 470] is now regarded as being really several different species of *Boletus,* including *B. granulatus, B. variegatus, B. luteus,* and *B. badius.* The perfect stages of *M. r. sylvestris* β and γ are not known, though the former has a resemblance to the mycelium of species of *Tricholoma* and the latter to that of *Cortinarius.* On the same tree several different fungi may be concerned in forming mycorrhiza.

Very full details of the author's successful attempts to synthesize mycorrhiza are given. With a fungus which is named *Rhizoctonia sylvestris* and briefly described, isolated near Berlin from the roots of *Pinus sylvestris,* the virulence of the action on the root was such as seriously to injure or even kill the inoculated plants, though mycorrhiza were sometimes formed.

The various theories concerning the nature of the mycorrhizal association are discussed, the author concluding from the results of synthetic culture experiments, from observations made under natural conditions, and from the anatomical structure of the mycorrhiza, that the root of the host and the mycorrhizal fungus live in mutual symbiosis. In the author's opinion it is only thanks to the mycorrhizal fungi that their tree-partners are able to survive on certain forest soils. In the absence of mycorrhiza the roots are attacked by the virulent *Mycelium radicis atrovirens* and by various common soil fungi capable of causing considerable damage.

The mutual reactions of both the partners in this harmonious association will form the subject of further researches by the author.

A bibliography comprising 85 titles is appended, while copious citations from the work of other investigators are scattered throughout the paper.

Costantin (J.). **Remarques sur les relations des arbres avec les champignons souterrains.** [Notes on the relations of trees with underground fungi.]—*Comptes Rendus Acad. des Sciences,* clxxviii, 2, pp. 158–161, 1924.

The author succeeded in cultivating *Tuber brumale* on sterilized artificial media, the composition of which is not indicated. In the space of a month he obtained very small fructifications (from 1 to 2 mm. in size) which produced asci and adult ascospores; the latter were dark brown and were covered with filamentose warts entirely

similar to those on the adult spores from which the cultures were started. Both the mycelium and the fructifications were at first covered with a very large number of small, hyaline, one-celled, oval or sometimes curved conidia, measuring from 6 to 10 by 2 to 3 μ. The author believes that a similar conidial form probably also exists in other species of *Tuber* and that it may play an important part in the dissemination of the fungus. On the ground of his experiments, he concludes that the oak is not necessary for the maturation of the ascospores, as believed by Matruchot, who only obtained sterile primordia of perithecia in artificial cultures of *T. melanosporum* and *T. uncinatum*.

FAWCETT (H. S.). **Influence of time and temperature on the rate of growth of certain fungi.**—Abs. in *Phytopath.*, xiv, 2, pp. 119–120, 1924.

Mycelia of *Pythiacystis citrophthora* and *Diplodia natalensis* were allowed to advance continuously in large, long glass tubes for 4 and 6 months in a uniform medium with only slightly fluctuating temperatures. After a short initial adjustment, both fungi grew at average rates, varying with the temperature. There appeared to be no staling with age, the former fungus, at 15·5° C., during the 4th and in the 11th week growing 27 mm. in each case, and the latter at 15·1° during the 7th week and again in the 19th and 21st weeks growing 23 mm., 24 mm., and 24 mm., respectively.

BOYLE (C.). **Studies in the physiology of parasitism. X. The growth reactions of certain fungi to their staling products.**—*Ann. of Botany*, xxxviii, 149, pp. 113–135, 5 graphs, 1924.

As a necessary preliminary to the determination of the chemical nature of staling products, the author has investigated the staling of a solution and attempted to discover how and to what extent the capacity for growth could be recovered.

The fungus used to produce the staling products was a species of *Fusarium* possessing very active staling properties. The cultures were made on Richards's solution, potato extract, and apple extract, using 50 c.c. in 500 c.c. conical flasks, and inoculating with 20 drops of a concentrated spore suspension. The progress of staling was measured by the inhibitive effect of the stale liquid on the germination and growth of spores of *Botrytis cinerea*, since the spores of this fungus are much more susceptible to the metabolic products of the *Fusarium* than are the spores of the *Fusarium* itself. The criterion of average germ-tube length better indicated the suitability of a medium for growth than percentage germination. The amount of growth of the *Fusarium* was estimated by the dry weight of the mycelial mat, and the hydrogen-ion concentration determined by the colorimetric method.

To test the possible influence of the exhaustion of food materials in slowing growth, the mycelium was filtered off from *Fusarium* cultures on apple extract and various proportions of unstaled apple extract or sterile distilled water added. The effect of dilution on the stale medium, whether with apple extract or with water, was to restore the capacity for germination and growth of *Botrytis*

sown in it. Good growth was obtained using 1 per cent. of staled extract in water, indicating that the inhibition of germination in staled media is not due to lack of nutrient materials.

The effect of boiling staled Richards's solution was to increase the growth of the *Botrytis* spores, but the effect decreased as the medium became increasingly stale. The increased growth, however, indicates the destruction of thermolabile substances which exerted a toxic influence in the staled medium.

Further experiments on the restoration of the germinative capacity of the staled medium were made with (1) Richards's solution, on which the fungus grows luxuriantly but stales slowly; (2) Richards's solution with 0·05 per cent. phosphate in place of 0·5 per cent. (which deposits phosphates on boiling from solutions approaching neutrality); and (3) potato extract, which is less favourable to mycelial growth but on which staling is rapid. On all three the fungus causes a decrease of hydrogen-ion concentration. To what extent this change is responsible for the toxicity of staled liquids is unknown, but the recovery of a slightly staled medium by readjustment to its original P_H value indicates that the latter is a limiting factor in such cases. Later, however, the correction of the P_H value has no apparent effect, doubtless on account of other inhibiting factors. Boiling and correction of the P_H value have a cumulative effect in promoting growth in a staled solution when separately they may be ineffective.

Cultures of the *Fusarium* and *Botrytis cinerea* on Richards's solution, apple extract, potato extract, and M/5 mannite of various reactions indicated that the P_H limits and optimum for growth of the two fungi are not absolute but depend on the medium on which they are grown. Since the medium is continually changing during staling, the P_H limits of growth may alter in consequence, but within wide limits the change in reaction is not, in all probability, a limiting factor for growth.

The beneficial effect of boiling a staled medium suggests the presence of an enzyme or volatile substance. The application of enzyme-precipitation technique to staled Richards's solution, potato and apple extracts showed that treatment with alcohol deactivates some of the growth-inhibiting factors, but that this effect becomes less apparent as the medium becomes increasingly staled. The results obtained, however, are difficult to interpret at the present stage. An attempt to extract soluble toxic substances from staled Richards's solution with ether was unsuccessful, and tests for oxalates in the staled media also gave negative results.

The effect of filtering stale Richards's solution through a collodion membrane was to remove some of the injurious factors, indicating that some of the staling substances in the solution are colloidal in nature.

Moore (Enid S.). **The physiology of Fusarium coeruleum.**—*Ann. of Botany*, xxxviii, 149, pp. 137–161, 2 pl., 4 figs., 6 graphs, 1924.

In this study two strains of *Fusarium coeruleum* were used, one originally identified by Wollenweber and a second isolated from a potato showing dry rot. Considerable variations as regards colour

production, parasitism, conidium and chlamydospore production, and in the habit of growth were noted very early in the work.

The cardinal temperatures for growth were: maximum at or near 30° C., minimum slightly below 5°, and optimum 15° to 25° C. Different types of growth developed at different temperatures. Heating the conidia for 10 to 15 minutes in water at 45° to 46°, or for a longer time at a lower temperature, was sufficient to kill them, and heating which is insufficient to kill the spores may delay their germination.

The P_H range tolerated by the fungus was 3·0 to 11·0. The initial reaction of the medium, however, is altered by the metabolism of the fungus and attempts to keep the reaction constant by means of a citric acid buffer were disappointing, as the citrate itself was consumed with the liberation of free alkali.

To test the effect of the concentration of the medium on growth, cultures were made in Coons's medium at normal strength, 10 N, 2 N, N/2, N/10, with and without agar. At 10 N a vigorous aerial mycelium is developed, but as the concentration is lowered growth becomes less until only a thin film is produced.

The common carbohydrates, glycerol, and sodium salts of tartaric, citric, and acetic acids were found to be utilized by this fungus. Colour production appears when the carbohydrate/nitrogen ratio is high, and the weight of mycelium varies with the sugar, being little influenced by the nitrogen concentration.

The concentrations (absolute and relative) of the substances utilized by the fungus as sources of nitrogen and carbon profoundly affect the reaction developed in the medium and consequently the fungal growth. The concentration of phosphate has relatively little influence.

Oxalates and formates are not utilized, while potassium nitrate, asparagin, and the ammonium salts of certain organic and inorganic acids can serve as sources of nitrogen.

The existence of both varietal and seasonal differences in the susceptibility of tubers has been confirmed. These differences appear to be due neither to varying sugar content nor to differences in acidity of the expressed juice. Neither can they be attributed to any difference in the cell walls of susceptible and resistant tubers when acted upon by a fungal extract.

Leonian (L. H.). **A study of factors promoting pycnidium-formation in some Sphaeropsidales.**—*Amer. Journ. of Botany*, xi, 1, pp. 19–50, 1924.

The study of some twenty representative members of the Sphaeropsidales and the organization in groups of their typical reactions (particularly from the standpoint of pycnidium production) was undertaken at Michigan University under controlled laboratory conditions.

A medium prepared according to the following formula was used exclusively throughout the experiments: dihydrogen potassium phosphate 1·25 gm.; magnesium sulphate 0·625 gm.; peptone 0·625 gm.; maltose 6·25 gm.; malt extract 6·25 gm.; and distilled water 1,000 c.c. For purposes of solidification 1·5 to 2 per cent. agar' filter paper, or powdered glass were added to the solution. With

this medium the influence of various factors, such as light, temperature, adsorption, oxygen supply, transpiration, solidity of substratum, reaction of media, and food-concentration, on the production of pycnidia, was tested.

When light was excluded, two organisms (*Hendersonia* sp. and *Sphaerographium fraxini*) failed to form pycnidia, twelve showed reduced reproduction, and the remaining six were unaffected.

A temperature of 30° C. generally induced better pycnidium formation notwithstanding the absence of light, and in the case of one organism which failed to fruit in the dark at room temperature (*S. fraxini*), it replaced the effect of light.

A decreased supply of oxygen suppressed fruiting in three organisms (*Melanconium betulinum*, *Phoma urens*, and *Steganospora acerinum*), and reduced it in eleven, while six remained indifferent.

Generally speaking, a higher food-concentration produced more numerous pycnidia, while luxuriant hyphal growth and pycnidium development were found to be parallel within a very wide range. This is in contrast to the results obtained by Klebs and other workers who, however, were dealing with relatively simpler reproductive bodies than pycnidia.

A sudden complete withdrawal of food from a mycelium grown in a very rich solution is not generally conducive to better reproduction, but when such a mycelium is transferred to a dilute nutrient solution instead of distilled water, the number of fruiting bodies formed may equal that at the higher concentration. A richly fed mycelium, after a subsequent period of starvation, gives rise, when again transferred to a dilute nutrient solution, to a great abundance of fruit bodies.

It is suggested that while starvation may furnish a stimulus for the formation of pycnidium-initials, their subsequent development requires a moderate amount of food.

LUNDEGÅRDH (H.). **Der Einfluss der Wasserstoffionkonzentration in Gegenwart von Salzen auf das Wachstum von Gibberella saubinetii.** [The influence of the hydrogen-ion concentration in the presence of salts on the development of *Gibberella saubinetii*.]—*Biochem. Zeitschr.*, cxlvi, 5–6, pp. 564–572, 2 figs., 1 diag., 1924.

In continuation of the author's earlier investigations on the growth of different species of *Fusarium* in varying hydrogen-ion concentrations [see this *Review*, ii, p. 382] a further series of tests was undertaken to ascertain whether the presence of salts modified the previous results.

Gibberella saubinetii was the fungus selected for the tests, and growth activity was measured by the estimation of the carbon dioxide produced.

Acid potassium phosphate was found to favour growth in peptone cultures even in an almost neutral solution, respiratory intensity increasing by approximately 50 per cent. as compared with the control: with increasing acidity, however, there was an abrupt decline in respiration, which was estimated at only 75 per cent. of the control at P_H 2·7 compared with 140 per cent. at P_H 6·8.

Calcium chloride exercised quite a different effect, respiration increasing only at acid concentrations (153 per cent. at P_H 4·7 compared with 86 per cent. at P_H 6·8). There is thus an ion-antagonism between calcium and hydrogen, analogous to that between calcium and magnesium in the higher plants. A further test showed that *G. saubinetii* resembles the higher plants in the latter respect, since the addition of varying solutions of calcium chloride neutralized the repressive action of magnesium given simultaneously, and led to increased respiratory activity. Similar results were obtained with cultures of *G. saubinetii* on soil, and there appears to be no doubt that under natural conditions the calcium ion plays a great part in the development of this fungus. Ammonium chloride was found to exercise effects in the same direction as, but somewhat less marked than, calcium chloride at P_H 5·1 to 5·5. Sodium had no perceptible action, while aluminium chloride completely arrested the growth of the fungus at P_H 3·4. This influence cannot be ascribed to a rise in the hydrogen-ion concentration, the rise being negligible.

LAURITZEN (J. I.) & HARTER (L. L.). **Species of Rhizopus reponsible for the decay of Sweet Potatoes in the storage house and at different temperatures in infection chambers.**—*Journ. Agric. Res.*, xxix, 6, pp. 441–456, 1 fig., 1923.

A description is given of the infection chambers and methods used by the authors in their attempt to determine whether all the nine species of *Rhizopus* capable of rotting sweet potatoes described by them in a former paper [see this *Review*, i, p. 272] infect sweet potato tubers over the entire temperature range of their growth, in cases where infection is dependent on wounding and particular species only are present, singly or in combination, on the tubers. The results showed that *R. tritici* and *R. nigricans* are the two species chiefly responsible for the decay of sweet potatoes known as soft rot. The former is responsible for the decay at the higher and the latter at the lower temperatures, with overlapping between 20° and 30° C. Although other species are capable of causing soft rot, they do not seem to do so under the storage conditions at Washington, D.C., and in the infection chambers at the different temperatures tested. In mixed inoculations at temperatures of 12°, 14°, and 18° C., *R. tritici*, *R. oryzae*, *R. reflexus*, and *R. artocarpi* cannot compete successfully with *R. nigricans*.

The temperature range of infection by *R. tritici*, *R. nigricans*, and species of *Mucor* is so wide as to leave little possibility of adjusting temperatures in stores beyond the limits of this range.

ARTSCHWAGER (E.). **On the anatomy of the Sweet Potato root, with notes on internal breakdown.**—*Journ. Agric. Res.*, xxvii, 3, pp. 157–166, 4 pl. (1 col.), 6 text figs., 1924.

The first part of this paper deals with the complex anatomy of the sweet potato root, the development of which is traced from the earliest stages. Its peculiar anomalous structure is largely due to the development of secondary cambiums and their products. In a mature fleshy root, the tissue internal to the cambium consists of (*a*) a peripheral zone of radially arranged xylem elements and (*b*) a

core of vascular tissue embedded in storage parenchyma. The larger vascular strands of the central core may be distinct and arranged at the periphery of a small circle, or scattered irregularly, or the bundles may join up forming an intricate network.

Tissue breakdown [described on pp. 164–166] is a disease which develops in storage. The initial symptoms are found in the interstitial parenchyma (found between the groups of bundles), the cells of which become more or less dehydrated and filled with air, which gives the tissue a pure white appearance. This parenchyma gradually acquires a spongy texture, leading finally to the formation of small, polyhedral chambers which are lined with the remnants of the destroyed tissue.

The process begins simultaneously at many points, spreading slowly from the centre of the fleshy root. Transverse zones of tissue may remain in certain places, breaking up the continuity of the longitudinal hollows, but in severely affected roots these diaphragms also break down, so that long, continuous air passages traverse the entire root. Except for the lignification of individual cells, the tissue lining the cavities usually undergoes no change, but occasionally a pronounced browning and partial lignification occurs all around the cavities and may spread to a depth of several layers. This browning is not due apparently to parasitic infection, and is considered to be an advanced stage of breakdown.

KÖHLER (E.). **Ueber die Beziehungen des Kartoffelkrebserregers (Synchytrium endobioticum [Schilb.] Perc.) zu seiner Wirtspflanze.** [The relations between the causal organism of Potato wart (*Synchytrium endobioticum* [Schilb.] Perc.) and its host.] —*Centralbl. für Bakt.*, Ab. 2, lxi, 1–4, pp. 32–37, 1924.

The author, basing his views on the results of a series of experiments, advances the hypothesis that immunity from wart disease (*Synchytrium endobioticum*) is due to the absence of a specific substance in the leafy shoots which exerts a toxic action on the underground organs into which it is conducted.

Four flower-pots were filled with a compost made up of four parts of a crumbling mass, consisting almost entirely of resting sporangia of *Synchytrium*, mixed with one part of sand. One tuber of the immune variety Preussen was planted in each of three of the pots and one of the susceptible Wohltmann in the fourth. The pots were placed in the greenhouse on 18th April 1923. On 16th July all the organs liable to attack were heavily infected in the Wohltmann plant, while the one Preussen tuber examined was found to be completely healthy. Subsequently the remaining Preussen tubers were also found to be perfectly sound.

It has previously been shown [see this *Review*, ii, p. 574] that specific varietal differences exist with regard to the size of the warts, and increased susceptibility has been found to run parallel with an increase in the dimensions of the excrescences. A difference has also been shown to exist at a particular moment in the degree of susceptibility in different parts of one and the same plant. In the moderately susceptible Rubia variety the tubers (except some of the smaller and later formed central ones), when lifted before complete maturity, are found to be almost free from excrescences,

the chief attack being at the base of the leafy shoots. Evidently, therefore, the secondary, adventitious shoots and the later tubers are susceptible to the disease, while the primary stolons with their tubers are not attacked. The contrasting behaviour of the early and late shoots cannot be due to varying degrees of infestation, since in this case the fungus could be detected in the eyes even of non-warted tubers. On the other hand, in susceptible varieties with long primary stolons that continue to form tubers, it will be observed that the attack on the underground system progresses from the older (proximal) to the more recent (distal) tubers, and in general the older parts of susceptible varieties are more warted than those newly formed.

The specific substance referred to above is presumably formed in large quantities even in the early stages of development of highly susceptible varieties and consequently reaches the first stolons and tubers; in moderately susceptible varieties the substance is formed in smaller amounts and the infection of the tubers takes place only at a late stage of development, the early ones escaping; while in completely immune varieties the toxic substance is not produced at all.

SCHULTZ (E. S.) & FOLSOM (D.). **Transmission, variation, and control of certain degeneration diseases of Irish Potatoes.**—*Journ. Agric. Res.*, xxv, 2, pp. 43–117, 15 pl., 1923.

In this paper are presented the results of the authors' extensive investigations and experiments on degeneration diseases of the potato, especially in connexion with transmission, variation, and control.

In the Green Mountain variety several types of degeneration, the symptoms of which are described, were distinguished and transmitted, namely, mild, leaf rolling, and rugose mosaic, streak, leaf roll, spindle tuber, and unmottled curly dwarf. The methods of transmission of each of these diseases are detailed. Leaf roll was not transmitted by contact except when actual grafts were made, nor by juice inoculations by the leaf mutilation method, but all the other degeneration diseases have beeen transmitted by this last method. Aphids have been shown to transmit all but streak.

Combinations of symptoms exist which indicate that more than one degeneration disease occurs in the same plant. Aphids sometimes transmit only one disease from such a plant, but more often the combination is perpetuated.

In 1921 the leaf roll and net necrosis percentages were found to increase, in the New White Hebron variety, with the average weight of the tubers.

The streaking which is a prominent symptom of streak is also believed to be a first season's symptom of rugose mosaic, and plants showing streak in the first year may therefore present a different aspect after tuber perpetuation.

Inoculations with juice in capillary glass tubes were much less effective than leaf mutilation inoculations with rugose mosaic and streak.

Several different symptom complexes yielded only rugose mosaic,

sometimes masked in the original complex, as the current-season effect of inoculation.

In greenhouse inoculations, mild mosaic was transmitted in some degree from Bliss Triumph to Green Mountain by means of the juice in capillary glass tubes, but not by immersion of a split stem in diseased juice. It was effected more readily with leaf-mutilation as the number of inoculated leaves was increased, and more easily with aphids as the number of insects was augmented, being possible, however, with only one individual.

Interspecific inoculations with leaf-mutilation and aphids indicate that tobacco mosaic is not identical with mild potato mosaic, that tomato is susceptible to both these forms of mosaic, and that nightshade (*Solanum nigrum*) is susceptible to mild mosaic of potato. Raspberry mosaic appears harmless to potatoes.

The virus of mild mosaic took about ten days to diffuse from inoculated leaves to the tubers.

Mosaic plants from the same seed tubers were found to show different symptom complexes in different environments, mottling being suppressed by higher temperatures in southern regions, where dwarfing of the tubers, on the other hand, is more pronounced.

Shading tended to increase mosaic mottling and to decrease leaf roll. In duplicate plots leaf roll and mosaic were contracted by healthy lots growing between rows of diseased lots, more in some regions than in others.

The digging of selected healthy hills progressively later in the growing season was correlated with greater numbers of aphids and with a higher incidence of disease in the progeny. Hill selection in fields containing diseased plants throughout the growing season fails to eliminate the disease but sometimes gives better results than the use of unselected stock from the same field.

Proximity and heavy aphid infestation increased the spread of mild mosaic, while sufficient isolation (over 400 metres) from diseased stocks reduced it.

STOKDYK (E. A.) & MELCHERS (L. E.). **Potato disease control in Kansas.**—*Kansas Agric. Exper. Stat. Bull.* 231, 45 pp., 16 figs., 1924.

The most important potato tuber diseases in Kansas are stated to be *Rhizoctonia* [*solani*], blackleg [*Bacillus atrosepticus*], *Fusarium* wilt, and scab [*Actinomyces scabies*]. Tipburn and early blight [*Alternaria solani*] are the only serious foliage diseases. The annual loss from these diseases, the symptoms of which are briefly described, varies from 15 to 30 per cent. of the crop.

For the control of *Rhizoctonia*, blackleg, and scab the corrosive sublimate treatment which has resulted in greatly increased yields, is recommended; experiments are in progress to determine the value of the hot formaldehyde method. Cold formaldehyde is not recommended for potato diseases.

Large increases in yield from spraying with Bordeaux mixture do not appear, from the writers' five years' experience, to result except in the case of serious epidemics of early blight or tip burn. The practice may be regarded in Kansas as a form of insurance against

possible loss, but hitherto the returns seem too small to justify the cost. These conclusions, however, are of a purely tentative nature. The use of the 4–5–50 or 4–8–50 formula is recommended in preference to a weaker solution.

Potato yields in Kansas have been materially augmented by seed treatment, the use of good yielding strains of certified seed, and the application of stable and green manure. Potatoes are at present being grown under irrigation in two districts with promising results.

Geise (F. W.). **Experiments with inoculated sulphur. Preliminary Report.**—*Virginia Truck Exper. Stat. Bull.* 42, pp. 259–263, 1923. [Received 1924.]

During 1922 experiments were carried out on the control of scab (*Actinomyces chromogenus*) [*A. scabies*] on Irish Cobbler potatoes by means of inoculated sulphur at the rate of 300, 450, or 600 lb. per acre.

From the practical standpoint the degree of control effected by the 300 lb. per acre treatment compares very favourably with the others, reducing the amount of disease from 71·82 to 66·51 per cent. from 64·55 to 16·70 per cent., and from 61·29 to 44·02 per cent. respectively in three separate tests.

The harmful residual effect on subsequent crops resulting from the use of excessive amounts of inoculated sulphur is an extremely important consideration. Late crops of potatoes were found to fail completely as a result of the heavier treatments, which also had an injurious effect on other subsequent crops, e. g. maize, rye, and spinach. Maize suffered even from the 300 lb. per acre treatment.

Reeve (A. T.). **A brown bast census.**—*Year Book Dept. of Agric., Ceylon*, pp. 14–15, 1924.

A census of rubber trees affected by brown bast was made on an estate in the Kelani Valley in order to ascertain the effect of thinning and a modified system of tapping on the incidence of the disease.

Three blocks of about 1,000 trees each were selected. Block A was a 20-year old clearing, B a 12-year-old clearing, and C 20 years' old rubber planted in exhausted tea land. In all blocks the present tapping system consists of 1 cut, half spiral, on alternate days, the cuts being changed over yearly.

In A, where the number of trees had been reduced from 215 to 93 per acre, the total percentage of brown bast (including trees with nodules, cracking, and discoloured bark) was 4·67.

In B, where the number of trees had been reduced from 100 to 83 per acre, the total incidence of the disease was 7·46 per cent. In this block the original tapping system was the same as that now in force, except that the cuts were not changed over yearly.

The trees in C were reduced from 150 to 109 per acre and the total incidence of brown bast was 2·66 per cent. In this field the trees showed a hard, thin type of bark and very poor renewal, which may be a factor in the low percentage of brown bast.

These figures are regarded as showing the influence of thinning

out on the decrease of brown bast. Block B, which was never subjected to drastic tapping, shows the highest percentage of brown bast, presumably because relatively few trees were removed during the thinning operations.

BERTRAND (H. W. R.). **Phytophthora leaf-fall of Rubber.**—*Trop. Agric.*, lxii, 3, pp. 144–146, 1924.

Phytophthora infections of rubber [*Hevea brasiliensis*] are stated to be a serious menace in Ceylon. During June and July when food reserves are at their lowest, the trees are frequently depleted of more than half their leaves in the prime of their activity. Between June and August 1923, this secondary leaf fall [which is due to *P. meadii* in the adjoining districts of South India but is regarded in Ceylon as due to a form of *P. faberi*: see above, p. 508] was so severe that, on many estates, the leaves, spread out, would have covered the whole acreage. Taking an estate of 600 acres, the daily loss of elaborated plant food would work out at about 10 tons.

Stem canker [*P. faberi*] is stated to cause great damage to the tapping bark, the branches being killed or rendered practically useless by the attacks of the fungus.

In the author's opinion, the various forms of *Phytophthora* are responsible for more damage to rubber estates than all the other diseases combined.

SIEVERS (F. J.). **Crop injury resulting from magnesium oxide dust.**—*Phytopath.*, xiv, 2, pp. 108–113, 1 fig., 1924.

Serious effects on vegetation in a valley of eastern Washington are stated to have resulted from the calcining, during the war, of a large deposit of magnesite rock for industrial purposes. Much of the magnesium oxide into which the raw material was converted was liberated together with the smoke and large volumes of carbon dioxide gas, and was deposited as a layer up to one inch in depth on the surrounding country.

Most of the plants grown on the affected area failed to penetrate the mortar-like crust of magnesium oxide, while those that succeeded in doing so rapidly developed the brownish discoloration characteristic of crops grown on excessively alkaline soils. Practically the entire root system was destroyed. The normal surface soil was found to contain about 4,000 lb. magnesium oxide per acre foot, while with increasing proximity to the industrial plant the amount rose to 56,000 lb.

In order to determine the part played by magnesium in the above-mentioned toxic action, oat seedlings were grown in mixed samples of the soil collected at various distances from the plant, one series of pots being also given 5 gm. of chemically pure magnesium carbonate. The oats on the untreated soil taken at a distance of 40 rods from the plant showed similar symptoms to those observed in the field; the addition of $MgCO_3$ failed to cause further injury. At 160 rods the oats on the untreated soil, though sickly, were superior to those in the pots receiving $MgCO_3$. Soil from a distance of two miles produced good oats both with and without the addition of magnesium (slightly better in the latter

case). These results are regarded as conclusive evidence that the undue quantities of magnesium present in the soil were injurious to the oats, while the normal soil of the valley in localities beyond the influence of the industrial plant does not contain a sufficient amount of magnesium or alkali salts to cause damage.

There is stated to be no reason to regard the present condition as permanent.

MATTHEWS (ANNIE). **Partial sterilization of soil by antiseptics.** —*Journ. Agric. Science*, xiv, 1, pp. 1–57, 25 diag., 1923.

Quantitative determinations were made at Rothamsted during 1918 to 1921 of the effect on soil protozoa and bacteria of various antiseptic substances, including benzene and its homologues and derivatives, carbon disulphide, ammonia, formaldehyde, and chlorpicrin. Rough determinations were also made of the effect on fungi, eelworms, and the like.

Nearly all the substances were found to disappear fairly rapidly from the soil, the numbers of bacteria fluctuating at the same time. There was usually a reduction during the first few days, followed by a rise to a maximum, and finally by a slow decline to the normal level. The entire process may occupy 400 to 500 days, being slower in field than in greenhouse soils. The rapidity of the changes was greatly influenced by aeration.

The increase of the bacteria during the initial stages of an experiment varied in the same direction as the molecular weights and heats of combustion of the antiseptics and is attributed to the latter property. Thus naphthalene, which has a large heat of combustion, caused incomparably higher rises in the bacterial population than did benzene with its lower heat of combustion. This increase was independent of the effect of the substance on the protozoa. Both naphthalene and toluene in large doses cause high rises, but the first has no effect on the protozoa, while the latter destroys all amoebae and ciliates.

Similar results were obtained when the experiments were made on soils already free from protozoa, e. g., a field soil bottled for 76 years and soils in which they had been killed by steaming and antiseptics respectively. In soils set aside for a long period after the destruction of the protozoa by a suitable antiseptic, a second dose caused an even greater rise than the first.

The rise in the number of bacteria is concluded, therefore, to be largely due to the feeding effect of the antiseptic on them and not merely to the destruction of the protozoa, the increased fertility observed by Russell and Hutchinson (*Journ. Agric. Sci.*, iii, Pt. 2, 1909, and v, Pt. 2, 1913) being attributable in a high degree to the activity of the greater bacterial population in breaking down the organic matter of the soil. It is, however, clearly stated that the author's results in no way conflict with the facts presented by the above-named investigators but merely open up another point of view.

Aliphatic compounds were found to cause quicker but smaller rises than those of the aromatic series. The introduction of a CH_3 group into the benzene ring diminishes toxicity to soil

organisms, while a single Cl or nitro-group increases both toxicity and stability in the soil.

The following is a list of substances arranged in descending order of toxicity to fungi :—(1) chlordinitrobenzene ; (2) dichlordinitrobenzene ; (3) o-chlornitrobenzene ; (4) nitrobenzene and dinitrobenzene ; (5) nitrodichlorbenzene ; (6) chlorbenzene, dichlorbenzene, and benzene.

RAGUNATHAN (C.). **Soft rot of Vanilla planifolia.**—*Year Book Dept. of Agric., Ceylon*, pp. 52–55, 1924.

Vanilla growing at the Peradeniya Experimental Station was attacked, in May 1922, by a fungous disease which in some cases produced a general soft rot and in others caused a definite grey spotting of the leaves. A *Colletotrichum* (? *C. vanillae*) and a *Gloeosporium* were isolated from diseased material of the former type, a *Volutella* and *Glomerella* appearing later on specimens in a closed glass dish ; plants affected by the latter type of disease yielded a fungus apparently identical with *Gloeosporium vanillae*. Other diseased specimens yielded a second species of *Glomerella*, but, like the first, this was found only in the conidial stage under field conditions.

The first symptom of the disturbance is a yellow discoloration of the stems or leaves, usually starting, on the former, from the bottom of a vine or at a node, and on the latter from the tip or middle of the leaf. Later on, especially under rainy conditions, the yellow patches on the stem turn chocolate-brown and shrivel up, the epidermis being raised in longitudinal ridges ; in a week or ten days the brown area is covered with crowded pink masses.

Affected leaves first turn yellow, then chocolate to dark brown. Minute pink pustules then appear, sometimes coalescing and subsequently turning very dark brown. The disease very rarely passes from leaf to stem.

The spore pustules of the four conidial fungi above mentioned were found on the stems, one being conspicuous as a white mass, surrounded by long, black, pointed setae. This assumes a pale pink, finally rose-purple, tinge. The other three fungi are salmon pink. The perfect stages of both species of *Glomerella* appear in large numbers on specimens kept in a moist dish.

Cultures were made of the *Colletotrichum* and the two species of *Glomerella*. The perfect stage of the *Colletotrichum* was not obtained. This fungus develops a thin, shining film of interlacing hyphae, bearing numerous conidia, and later a sparse, floccose, aerial mycelium. After 18 days pink pustules with olive-brown setae appear all over the medium.

Glomerella sp. 1 is the perfect stage of the above-mentioned *Volutella*. It develops a thin, hyaline, mycelial growth, dotted, after five days, with greenish-black bodies, which increase so as to cover the whole dish. Setae and conidia appear in abundance, followed, after a month, by clusters of perithecia on stromatic masses. The perithecia are black with a light brown ostiolum, globose-conoid or broadly flask-shaped.

Glomerella sp. 2 develops a circular, thin, white, superficial growth in three days, in which greenish-black spots subsequently

appear. Pink masses of conidia are formed in a fortnight. Setae do not occur on maize meal agar, but are found in small numbers on sterilized vanilla material. Groups of black, superficial, subconoid perithecia ultimately appear on stromatic masses.

The spore characters of these fungi are not described.

Inoculation experiments were made on plucked leaves and stems in the laboratory and on living vines in pots. All attempts to produce infection through unwounded surfaces gave negative results. When inoculated through wounds on plucked leaves and on living vines the conidia germinated and formed appressoria but failed to make further progress. All the inoculations on stem cuttings in moist dishes were successful with the three fungi in 7 to 10 days. Two of the inoculated leaves on the vines developed the symptoms of the disease two months after exposure to natural conditions, the last four days of the period having been characterized by incessant rainfall.

The plants were sprayed in May 1923 with 1 per cent. (5–5–50) Bordeaux mixture. No symptoms of the disease had appeared by August in spite of the wet season, but it is not yet possible to state whether this was due to the treatment or to some other cause.

BREMER (G.). **Onderzoek over de afstervingstemperatuur van Bacterium herbicola.** [Investigations of the thermal death point of *Bacterium herbicola.*]—*Meded. Proefstat. Java-Suikerind.* 3, pp. 55–64, 1924.

In connexion with Miss Wilbrink's trials of the hot water treatment for the control of sereh disease of sugar-cane [see this *Review*, ii, p. 468], an investigation was made of the thermal death point of five strains of *Bacterium herbicola*, an organism which was consistently isolated by Wolzogen Kühr from sereh-infected canes [see this *Review*, iii, p. 302].

The cultural characters of the five strains are described in detail. In glucose-peptone-K_2HPO_4 cultures the thermal death points were: for strain 1, 48° C.; for 2, 52°; for 3 and 4, 48° to 49°. In maltose-asparagin-K_2HPO_4 cultures they were 51° and 55° for strains 1 and 2 respectively, and in sugar-cane juice for the same two strains 50° to 51° and 56° respectively. Strain 5 was tested only in cane-juice, its thermal death point being 56°.

Tests were made of the requisite duration of the heating process for the destruction of the various strains. Strain 2, cultured in cane-juice, was killed by heating at 55° for 20 or 30 minutes; after 10 and 15 minutes a few colonies were still alive. Twenty minutes exposure to a temperature of 54° was not sufficient to kill this strain, and 30 minutes' exposure to 53° was less effective than 15 minutes at 55°. Cultured in cane-juice, strain 1 succumbed to 15 minutes' exposure to 50°, but not to 25 minutes at 49°. Thus at even slightly lower temperatures the duration of exposure must be considerably prolonged in order to ensure complete destruction.

In another experiment 12 infected canes were placed for 30 minutes in water heated to a temperature of 52°, after which *Bact. herbicola* was isolated from only 2 of the canes. In 10

other canes exposed (after preliminary heating) to a temperature of 53° to 54°, the organism was completely destroyed in the same time.

It may be concluded from these experiments that the thermal death point of *Bact. herbicola* lies round about 50°, and that most, if not all, strains of the organism would be destroyed by hot water treatment based on Miss Wilbrink's methods.

JACZEWSKI (A. DE). **Грибы России. Видовой определительгрибов. (Несовершенные грибы).** [Fungi of Russia. Key for the determination of species of fungi (Fungi Imperfecti)]. II, 1.—Edited by the *Editing Committee of the People's Commissariat of Agriculture,* 64 pp., Petrograd, 1922. [Received 1924.]

We have recently received the first part of the second volume of the present work which, as stated in the introduction, is a third entirely revised and considerably enlarged edition of the author's key for the determination of the genera of the fungi of Russia. The entire work comprises two volumes, the first dealing with the Fungi Perfecti and the second with the Fungi Imperfecti. The species under each genus are described, and many of them are illustrated, while keys for their rapid determination are provided. Under each species the synonyms are listed, and the excluded species, with reasons for their exclusion, are appended to the genera.

To enable non-specialists to use the book more readily, species are grouped by their substratum, i. e., by the hosts harbouring them, and special attention is paid to their geographical distribution within the pre-war administrative limits of Russia, excluding Finland.

GONZÁLEZ FRAGOSO (R.). **Contribución á la flora micologica lusitanica.** [Contribution to the Portuguese mycological flora.]—Reprinted from *Bol. Soc. Broteriana* [*Coimbra*], ii, 2nd Ser., 83 pp., 1 col. pl., 25 figs., 1924.

In this valuable paper the author has listed 301 species of fungi, mostly Ascomycetes and Fungi Imperfecti, belonging to the Portuguese flora. Many new species and a new genus *Sampaioa* (Lophiostomaceae) are described, Latin diagnoses and, in most cases, illustrations being given.

BERKHOUT (CHRISTINE M.). **De Schimmelgeschlachten Monilia, Oidium, Oospora en Torula.** [The fungus-genera Monilia, Oidium, Oospora, and Torula.]—*Dissert.*, 71 pp., 4 pl., Utrecht, 1923. [Received 1924.]

This is an attempt to reduce to a common nomenclature some fungi kept in pure culture at the Centraalbureau voor Schimmelcultures, Baarn, Holland. The genus *Monilia* in particular is represented by very heterogenous elements, which have been contributed by mycologists, doctors, and biochemists. The author reserves the genus *Monilia* Gmelin Pers. 1801 emend. Sacc. for forms with definite conidiophores and chains of lemon-shaped conidia, and which develop aerial mycelium in culture. It comprises the fruit-rotting parasitic forms, and two saprophytes, *M. aurea* Gmelin and

M. sitophila (Mont.) Sacc. A new genus *Candida* is erected for those forms which in external appearance in culture resemble yeasts, but do not form ascospores. The type species is *C. vulgaris* Berkh. (= the *Monilia candida* Bon. of Hansen), and the genus includes a number of human pathogens. *Oidium* Link emend Sacc. is reserved for the conidial forms of the powdery mildews. *Oospora* Wallr. emend. Sacc. is characterized by the formation of spherical or oval conidia in regular chains, or by the chain-like breaking up of the mycelium (oidial formation). The oldest described species is *Oospora lactis* (Fresen.) Sacc. and a number of others are now known, mostly saprophytes from cheese, soil, and the like, with two species from the human body. The genera *Candida* and *Oospora* bear the same relation to one another as do the 'oidial' and 'yeasting' species of *Endomyces*. *Torula* Pers. emend. Sacc. is characterized by chains of dark-coloured conidia, borne on little-differentiated conidiophores. The pink and white yeasts without known endospores, referred to this genus by the biochemists, must be excluded. *Dematium* Pers. was originally described as having erect, branched conidiophores, bearing lateral chains of conidia. *Dematium pullulans* de Bary and Loew does not come within this definition and is made by the author the type of a new genus *Pullularia*, as *P. pullulans* (de Bary Loew) Berkh.

Coker (W. C.). **The Clavarias of the United States and Canada.**—209 pp., 92 pl., Univ. North Carolina Press, 1923. [Received 1924.]

In this book, which is at once scientific and popular, the author describes and figures 83 species of *Clavaria*, with a number of varieties. Many of these are edible and some very palatable. They are divided into ten groups, the probable affinities of which are indicated. The spore characters are stated to be of great value for specific diagnosis, and the fact is recorded for the first time that successive hymenia may be formed, as in some Polypores. Species of *Lachnocladium*, *Typhula*, and *Pterula* with which the author is familiar are included. The photographs, the coloured plates, and the drawings of hymenial structure supplement the text and should render diagnosis easy.

Welles (C. G.). **Observations on taxonomic factors used in the genus Cercospora.**—*Science*, N.S., lix, 1522, pp. 216–218, 1924.

During 1921–22 the author carried out a series of investigations in Central Luzon, Philippine Islands, to test the validity of the taxonomic factors commonly employed in the classification of fungi, belonging to the genus *Cercospora*, namely, spore dimensions, host reaction to parasite, and known host range of the latter.

Pure cultures on various media were made of *C. lussoniensis* from *Phaseolus lunatus*, *C. manihotis* from *Manihot utilissima*, *C. melongenae* from *Solanum melongena*, *C. duddiae* from *Allium cepa*, and *C. averrhoi* from *Averrhoa carambola*.

Conidiophores and conidia from lesions on the following hosts were measured during the dry and rainy seasons respectively:

Dolichos lablab (*C.* sp.), *Ipomoea batatas* (*C. batatae*), *Phaseolus lunatus* (*C. lussoniensis*), *Psophocarpus tetragonolobus* (*C.* sp.), *Sesamum orientale* (*C. sesami*), and *Solanum melongena* (*C. melongenae*). The fruiting structures were found to be 50 to 150 per cent. longer when produced during the rainy season, and it was shown by experiments with four species that the conidia on leaves exposed to a saturated atmosphere for 3 to 4 days were 30 to 80 per cent. longer than those from undisturbed field lesions collected at the same time.

The measurements of fruiting structures produced by inoculations during the rainy season with pure cultures of *C. lussoniensis* on *P. lunatus*, *P. aureus*, *D. lablab*, *Cucurbita maxima*, *Glycine max*, *I. batatas*, *Macaranga tanarius*, *Manihot utilissima*, *Psophocarpus tetragonolobus*, *Ricinis communis*, *Sesamum orientale*, *Vigna catjang*, and *V. sinensis*, ranged from 71·9 to 126·5 μ for the minimum length of the conidia and 127·9 to 236·0 μ for the maximum.

When plants were inoculated with pure cultures of *C. lussoniensis*, *C. manihotis*, and *C. melongenae*, the conidia produced by each fungus on the same host were so similar that separation by means of measurements or other physical characters was impossible.

These results are regarded as showing that morphological differences of the type discussed, unless extremely pronounced, are of little value as taxonomic criteria in *Cercospora*. Host reaction, too, is an unreliable factor, the type of leaf being apparently more important than the type of irritation applied. Physiological behaviour on artificial media and the extent of parasitism are stated to be the only dependable criteria for the separation of the various species of the genus.

WAKEFIELD (ELSIE M.). **On the names Sclerotinia sclerotiorum (Lib.) Massee and S. libertiana Fuckel.**—*Phytopath.*, xiv, 2, pp. 126–127, 1924.

The fungus known as *Sclerotinia libertiana* was described under the name *Peziza sclerotiorum* by Madame Libert in 1837. Fuckel in 1869–70 changed the name to *S. libertiana*, citing *Peziza sclerotiorum* as a synonym. According both to the American Code and the International Rules of Nomenclature, Fuckel should have retained the specific name, and hence the combination *S. sclerotiorum* first used by Massee in 1895 must stand.

WELLENSIEK (S. J.). **De identiteit van Kweekkasschimmel met Aardappel-Rhizoctonia.** [The identity of the 'frame fungus' with the Potato *Rhizoctonia*.]—*Tijdschr. voor Vergelijkende Geneesk. enz.*, x, 2–3, 5 pp., 1924. [French and English summaries.]

A series of experiments was conducted to verify Duggar's conclusions (*Ann. Missouri Bot. Gard.*, iii, p. 1, 1916) regarding the identity of *Rhizoctonia solani* and *Moniliopsis aderholdi* [see this *Review*, ii, p. 470].

It was found that *R. solani* has somewhat thicker hyphae than *M. aderholdi*, the former being about 9 to 10 μ in diameter and the latter about 5 to 7 μ. A more important difference lies in the fact

that *M. aderholdi* absolutely failed to parasitize potatoes, on which 60 inoculation tests were made, while 38 out of 40 similar experiments with *R. solani* gave positive results. In all the successful inoculations with *R. solani*, the *Hypochnus* form [*Corticium solani*] developed, while in the tests with *M. aderholdi* and in the controls this form did not appear.

These results are regarded as conclusive evidence that *R. solani* and *M. aderholdi* are two distinct organisms.

Brown (W.) & Horne (A. S.). **Studies of the genus Fusarium.**—*Ann. of Botany*, xxxviii, 150, pp. 379–383, 1924.

Starting with six forms of *Fusarium* isolated from various natural substrata, such as rotting apple fruit, and possessing certain features in common, though no two were identical, the authors tested their variability in pure culture. From single-spore cultures numerous saltants were obtained, and some 40 strains were produced from the original six. On a synthetic medium composed of glucose, potato starch, asparagin, magnesium sulphate, and neutral potassium phosphate it was found that the various growth forms of the fungi could be widely varied by altering the proportion of the nutrients, the most important being the carbon : nitrogen ratio. When this was low the colonies were colourless, staling rapidly developed, the spores were short, with low septation, and were short-lived; when high the colonies were coloured, did not stale, the spores were long, with high septation, and were long-lived. In each form the septation mode could be brought down to 1 or raised to 5 or more by suitably altering the medium.

Amongst the 40 strains some are now indistinguishable from each other though they have arisen from different members of the original six, and typical members of all the groups have been derived from a single spore parent. It is concluded that all are derivable from a single original parent. This is named *F. blackmani* n. sp. No diagnosis is given, but it is stated to be characterized by the absence of a *Cephalosporium* stage and of typical chlamydospores, the orange colour of the spore masses, and the fairly constant shape of the spores.

Palm (B. T.) & Jochems (S. C. J.). **Invloed van peteh tjina (Leucaena glauca) op de stengelverbranding van Tabak.** [The influence of peteh tjina (*Leucaena glauca*) on stem rot of Tobacco.]—*Vlugsch. Deli Proefstat. te Medan* [Sumatra], 24, 4 pp., 1 diag., 1924.

Peteh tjina (*Leucaena glauca*), which is extensively used as a green manure in the Medan (Sumatra) tobacco fields, has been found to be highly susceptible, not only to slime disease [*Bacterium solanacearum*] but also to stem rot (*Pythium*). Cases have been observed in which 80 to 90 per cent. of infection by the latter disease occurred on tobacco in a *Leucaena* field, the rest of the crop being perfectly healthy. The *Leucaena* plants were also diseased, and cross-inoculation experiments with the fungus isolated from both hosts gave positive results.

Phytolacca octandra has also been observed to convey stem rot

to tobacco, cross-inoculation tests establishing the connexion in this case also.

Mimosa [*invisa*] appears to be resistant to stem rot as well as to slime disease [see this *Review*, iii, p. 109] and its use as a green manure is again urged.

HUBERT (E. E.). **The red stain in the wood of Boxelder.**—*Journ. Agric. Res.*, xxvi, 10, pp. 447–457, 3 pl. (1 col.), 2 figs., 1923. [Received 1924.]

Since 1920 the author has made a study of a widespread disease of box-elder (*Acer negundo*) in Wisconsin, characterized by a bright red stain in the wood. So frequent is the occurrence of this disease that the red coloration is popularly regarded as a reliable character for the identification of box-elder wood.

The cause of the discoloration, which ranges from light coral-red to hellebore-red or carmine in the heartwood, and which also occurs, though to a lesser extent, in the sapwood, has been found to be due to the presence in the wood of a soluble red pigment produced by the hyphae of a fungus, *Fusarium negundi* Sherb. n. sp., an English diagnosis of which is given. The causal organism appears only to be weakly parasitic or to develop in injured tissues, since it is found in the sapwood, chiefly surrounding wounds inflicted by sap suckers. The latter also probably effect the dissemination of the spores from one part of the tree to another, or from tree to tree. No evidence of penetration through living tissue in the absence of wounds was obtained.

The wood of box-elder is largely used for various branches of cabinet-making and also for paper pulp, and for these purposes the clear, creamy-white colour of the normal wood is preferred. The presence of the stain may lower the grade of the stock and reduce the price. The not infrequent association of the red staining organism with wood-rotting fungi, e. g. *Collybia velutipes*, *Pleurotus ulmarius*, and *Fomes applanatus*, in the same tree, necessitates caution in the use of affected material.

The geographical distribution of the red stain disease is assumed to coincide with the range of the box-elder. It has been reported from many parts of the United States, and an apparently identical trouble occurs in a few places in Europe.

The best means of control are believed to be the proper care of wounds on trees grown for shade and, for forest trees, the burning of affected slash and the rapid handling of diseased logs.

Gegen die Einschleppung und Verbreitung des Kartoffelkrebses. [Against the introduction and dissemination of Potato wart disease.]—*Nachrichtenbl. deutsch. Pflanzenschutzdienst*, iv, 2, pp. 11–12, 1924.

As from 24th September 1923 consignments of potatoes will only be admitted into Luxembourg when accompanied by a certificate from the country of origin stating that they were grown in an area immune from wart disease [*Synchytrium endobioticum*], i. e., at a distance of not less than 20 km. from the nearest centre of infestation. Potatoes from areas more than 5 but less than 20 km. from

infested centres may, however, be imported on production of a certificate of freedom from wart disease.

Pflanzenschutzdienst in Luxemburg. [Plant protection service in Luxembourg.]—*Nachrichtenbl. deutsch. Pflanzenschutzdienst*, iv, 2, p. 11, 1924.

By a decree of the Luxembourg Minister of Agriculture of 24th September 1923 a plant protection inspection service has been established. Experts will examine all nursery-gardens and other establishments engaged in the sale of plants, for the presence of insect pests and plant diseases, certificates of exemption (valid for six months) being issued in the case of freedom from infection. Such inspections must be conducted at least every six months. Special provisions are made for the inspection and certification of outgoing and incoming consignments of plants, and for the compulsory notification of the occurrence of diseases.

Pflanzenschutzdienst in Ungarn. [Plant protection service in Hungary.]—*Nachrichtenbl. deutsch. Pflanzenschutzdienst*, iv, 2, p. 11, 1924.

The annual losses from insect pests and plant diseases in Hungary are estimated at 40 to 50 milliard kroner of the present currency, and official steps are being taken to improve the situation by extension of the Physiological and Phytopathological Institute in Budapest, and by the promulgation of plant protection legislation. A national plant protection institute is to be established, comprising sections of plant pathology, plant physiology, entomology, biochemistry, forestry, plant protection, and the testing of disinfectants. Local branches will be established in the various provinces and special arrangements made for frontier supervision of plant imports. The plant protection legislation will provide, *inter alia*, for the compulsory treatment of plant diseases known to be controllable by certain well established methods; the isolation of infected areas ; the compulsory notification of diseases ; and the control of plant imports and exports by means of inspection. Arrangements are to be made for the inclusion of instruction regarding plant protection in the curricula of schools and colleges.

The mosaic disease of Sugar-cane Order 1923.—*Journ. Jamaica Agric. Soc.*, xxviii, 1, p. 27, 1924.

By an Order dated 17th December 1923 the cultivation of maize is prohibited on any sugar estate or cane farm in any part of Jamaica or within 200 yards from the boundary of any such estate or farm, with a view to preventing the spread of mosaic disease [see this *Review*, iii, p. 366].

IMPERIAL BUREAU OF MYCOLOGY

REVIEW

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Sherwood (E. C.). **Hydrogen-ion concentration as related to the Fusarium wilt of Tomato seedlings.**—*Amer. Journ. of Botany*, x, 10, pp. 537–552, 1 pl., 1923.

Investigations were carried on at the Wisconsin Department of Plant Pathology with a view to supplementing those of Clayton on the influence of temperature and moisture [see this *Review*, ii, pp. 428, 477] upon the development of tomato wilt (*Fusarium lycopersici*). Edgerton (*Phytopath.*, viii, p. 5, 1918), in his work on the correlation between soil reaction and the development of wilt, has demonstrated the importance of liming in the reduction of the disease. Both these investigators and the author found that, within reasonable limits, the age of the culture does not appreciably affect the virulence of the organism.

The experiments described in the present paper were conducted on acid sandy and silt loam soils, adjusted to different degrees of acidity and alkalinity and inoculated with *F. lycopersici*, in a greenhouse where the temperature was maintained at or near 28° C. (the optimum for the development of the disease). It was found that the highest percentage of wilt uniformly occurred in the most acid soils of the series, decreasing, in almost every case, with a reduction in the hydrogen-ion concentration until approximately P_H 7·4 was reached : no limiting degree of acidity and alkalinity was found at which the disease would not develop. The amount of infection, however, showed considerable variation under the conditions of the several experiments. It is evident, therefore, that other influential factors, such as nutrition, aeration, and organic matter content, play an important part in the development of the disease. Considerable differences were also observed in the incidence of disease in the two types of soil at the same hydrogen-ion concentration.

The critical period of infection in the seedlings appears to occur within the first few days after germination. The primary xylem was always found to be affected.

Culture experiments were carried out with *F. lycopersici* in nutrient solutions adjusted to hydrogen-ion concentrations ranging

from P_H 1·8 to 8·4. Spores of the organism exposed to the same temperatures as the growing tomato seedlings germinated in the solutions varying between P_H 2·2 and 8·4. No germination occurred at P_H 1·8, and the growth of the fungus at P_H 2·2 was so slight as to cause no change in the reaction of the medium. Growth was good at all concentrations from P_H 2·8 to 8·4; in one case there was a slight change at the former concentration in the reaction of the medium towards greater alkalinity. At all hydrogen-ion concentrations from P_H 3·6 to 8·4, the growth of the organism was accompanied by changes towards greater acidity.

SHAPOVALOV (M.). **Effect of environmental conditions on western yellow blight of Tomatoes.**—Abs. in *Phytopath.*, xiv, 2, pp. 120–121, 1924.

The distribution and seasonal prevalence of western yellow blight of tomatoes depend primarily on climatic conditions, being favoured by high temperatures, low humidity, and high evaporation. These conditions may predispose the host to infection or may favour aggressive fungal activity. *Fusarium* spp. and *Rhizoctonia solani* have chiefly been isolated from affected roots, but their exact rôle has not been determined. A physiological collapse of the small rootlets probably precedes infection.

SMITH (R. G.). **A chemical and pathological study of decay of the xylem of the Apple caused by Polystictus versicolor Fr.** —*Phytopath.*, xiv, 2, pp. 114–118, 1924.

In this paper are presented the results of the two proximate chemical analyses [the technique of which is described], the first of normal apple wood (*Pyrus malus*), the second of the same wood altered in composition as a result of attack by *Polystictus versicolor.*

The dry weight analyses, calculated on the basis of 63 gm. for unaltered wood (Sp. G. 0·63) and 44 gm. for altered wood (Sp. G. 0·44), showed a negligible increase in the amount of lignin, indicating that lignin is unchanged by the action of the fungus. Undetermined constituents are likewise unaltered. An increase in the benzene extract is thought possibly to be due to the accumulation of resinous by-products incidental to the activity of the fungus. All other constituents (viz. alcohol extract, starch, hemicellulose and cellulose) appear to be definitely attacked.

BOYCE (J. S.). **Investigative work on white pine blister rust in the Pacific Northwest for 1922.**—Abs. in *Phytopath.*, xix, 2, p. 124, 1924.

White pine blister rust [*Cronartium ribicola*] was probably introduced into the Pacific Coast region in 1910 on a shipment of eastern white pines [*Pinus strobus*] from France which were planted at Vancouver. In twelve years the rust has extended over a triangular area roughly 300 miles or more on a side, being widespread in the coastal region of British Columbia and Washington. Spread is retarded by dry growing seasons and accelerated by wet ones. All western species of *Ribes* and *Grossularia* are susceptible.

while the western white pine [*P. monticola*] seems more susceptible than the eastern.

MÖBIUS (M.). **Ueber das Grauwerden des Holzes.** [The grey discoloration of wood.]—*Ber. deutsch. Bot. Gesellsch.*, xlii, 1–2, pp. 15–18, 1 fig., 1924.

Poles, planks, huts, barns, and similar wooden structures which have long been exposed to the weather are frequently found to have assumed a silvery-grey tinge on the surface, the deeper layers being white or yellowish. Coniferous wood, usually that of *Picea excelsa* or *Pinus sylvestris*, appears to be chiefly affected, but the same phenomenon has also been observed on the timber of deciduous trees.

A longitudinal section through a segment of fir wood showing this condition revealed about five external layers of tracheids with hyaline walls enclosing a fungus resembling a sooty mould. Underneath was a stratum, about twice as thick as that comprising the outer layers, with brownish-yellow tracheid walls but showing no trace of the fungus; this merged into the internal, hyaline portions of the wood. In all the affected specimens examined by the author the fungus was always found in the exterior tracheids or wood cells; it never occurred in wood treated with a preservative.

The hyphae of the fungus have short cells, averaging 3 to 4 μ in thickness, and they tend to become clumped into irregular masses of rounded cells, isolated or in groups, occasionally united to one another by hyaline hyphae. Reproduction appears to be effected chiefly by *Torula*-like segments of the mycelium. The fungus differs from the sooty moulds in its location in the interior of the substratum.

Various instances are cited of the development of a grey colour resulting from the superimposition of a hyaline, translucent layer on a dark background. Cases similar to that described above are stated to be less frequent, but some examples are quoted, especially the grey colour in certain stages of *Coprinus atramentarius*.

HUMPHREY (C. J.). **Decay of lumber and building timber due to Poria incrassata (B. & C.) Burt.**—*Mycologia*, xv, 6, pp. 258–277, 3 pl., 1923.

Poria incrassata (B. & C.) Burt., a brief descriptive and historical account of which is given, causes a decay of timber quite similar to that produced by *Merulius lacrymans* and has probably been frequently confused with the latter, as it is often found in a sterile condition. It has not yet been observed developing in structures where the air is kept very humid by artificial means or through manufacturing processes, such as weaving and dye sheds, paper mills, &c., but it is frequent in other buildings throughout the United States.

Infections generally start in moist, cool places, preferably on timber in contact with the ground or close to it. The mycelium frequently forms extensive and characteristic fan-shaped sheets,

particularly when developing between two adjoining timbers; it is whitish when young, and becomes tinged with yellowish-olive to brown as it ages. In some cases rhizomorphs are present. When young these rhizomorphs are white and very small, but as they mature they take on a brown to brownish-black colour and are frequently flattened; they are largest near the ground and may appear as heavy, root-like growths, very similar in structure to the rhizomorphs of *Merulius lacrymans.*

The most striking feature of the fresh fruit-bodies is the colour, which varies with the intensity of illumination from orange to pale olivaceous; when growing entirely in the dark there is no trace of orange, but when the mycelium grows through cracks in a floor into a lighted room it may form orange-coloured cushions. When the fungus fruits in the open, the fructifications are much firmer in texture and often develop a thick, whitish subiculum, of compact, vertical hyphae, which cracks widely on drying, the context then being in sharp contrast to the brownish or blackish-brown pore surface. Other specimens, more or less abortive in character, strongly resemble compact liver both in colour and consistency.

Pure cultures of the fungus were made and its temperature relations were determined; the optimum for growth appears to be 28° C., the maximum between 32° and 34°, and the minimum below 12°, growth being slow at the latter temperature (which was the lowest tested). The action of the organism was also tested on various woods, comprising representatives of 13 genera of conifers and 25 genera of broadleaf trees. The results, given in a tabular form, show that the fungus is capable of attacking and destroying almost all of the commercial woods of the United States.

Numerous examples are given of the damage caused by the fungus both in timber yards and in finished buildings of all types. The losses, in the author's estimation, must run into hundreds of thousands of dollars yearly, and are increased by the fact that the fungus not only destroys the timber of the buildings but will also readily attack and damage all woody objects in contact with the decayed timber.

Control measures should be first of all directed towards preventing new infections, in which connexion two points are of main importance, namely, an improvement of the sanitary conditions in the timber stores, and suitable changes in building design, so as to eliminate, as far as possible, the more favourable conditions for the development of the fungus. A summary is given of the precautions which a builder should take in buying and in employing his timber with a view to reducing the risks of infection. Once the fungus has gained entrance the only feasible remedy is complete eradication.

ZELLER (S. M.). **Decay of Douglas fir due to Poria incrassata.**—Abs. in *Phytopath.*, xiv, 2, p. 119, 1924.

Spores of *Poria incrassata* germinate readily on damp soil and coniferous wood, and this fungus has been found to damage severely timber of Douglas fir in contact with soil which serves as a source of moisture.

Plíseň řepná. [Mildew of Beetroot.]—*Ochrana Rostlin*, iii, 3–4 p. 32, 1923.

In this brief note is recorded a serious outbreak in 1923 of *Peronospora schachtii* on sugar beets [see this *Review*, ii, p. 484] in two localities of Czecho-Slovakia. The fungus, which hitherto was considered to be of but small economic importance, was found heavily attacking and rapidly killing the youngest leaves in the heart of the crown, thus interfering with the assimilation processes and considerably reducing the sugar content of the root. The organism is capable of overwintering in the roots and leaves in the form of oospores, and as it is seed-borne it presents considerable danger to seedlings in the nurseries. Control measures should consist in roguing all diseased plants as soon as they appear and in spraying with 2 per cent. Bordeaux mixture; sprayed beets have been observed to be richer in sugar than the unsprayed.

CLAYTON (E. E.). **Investigations of Cauliflower diseases on Long Island.**—*New York (Geneva) Agric. Exper. Stat. Bull.* 506, 15 pp., 8 pl., 1 graph, 1924.

The chief diseases of cauliflower occurring on Long Island, New York, are described and figured, with directions for control measures in each case.

Peppery leaf spot (*Pseudomonas maculicolum*) produces small, circular, purplish lesions which are most conspicuous on the under side of the leaves, especially those nearest the ground. The disease occurs in the spring, early summer, and late autumn, being entirely absent during the hottest months. Cabbage is also occasionally affected.

The damage caused by the disease is not usually severe, infection as a rule being rapidly outgrown. The causal organism persists in the soil, and is probably indigenous to Long Island, being encountered even in virgin soil. Rain is believed to be almost the sole agent of dissemination.

Sterilization of the seed in hot water is beneficial, but the disease is seldom severe enough to necessitate this measure.

Whiptail, generally due to malnutrition consequent upon unsuitable soil conditions, produces various malformations, such as narrowing and ruffling of the leaves, stunting of the plants, and leafy culls. The incidence of infection is frequently very high, especially on plots receiving abundant supplies of artificial fertilizers. The results of a series of experiments proved conclusively that the addition of lime, at the rate of 800 to 900 lb. per acre, completely counteracted the adverse effects of the fertilizer and reduced the degree of infection to a minimum.

Sulphur, which is extensively applied to Long Island soils for the control of potato scab [*Actinomyces scabies*], usually causes severe epidemics of whiptail in cauliflower planted the following year. This greatly complicates the cultivation of these two crops in the same rotation.

During the severe aphid epidemic of 1923 much whiptail developed in the plantations most injured by the insects. The disease was largely controlled by the application to the plants of nicotine preparations.

Burkholder (W. H.). **The effect of varying soil moistures on healthy Bean plants and on those infected by a root parasite.** —*Ecology*, v, 2, pp. 179–187, 1924.

The results of experiments on Wells's Red Kidney beans [*Phaseolus vulgaris*], conducted in 1920 in Wisconsin and in 1921 and 1922 at Cornell, showed that the optimum soil moisture for healthy bean plants is about one-half the water-holding capacity. Beans grown in a dry soil up to blooming time, and thus considerably dwarfed, will quickly respond if the soil be changed to a wet condition (two-thirds of the water-holding capacity).

Plants infected by *Fusarium martii phaseoli* were found to show a greater reduction in yield in dry than in medium wet or wet soils. Infected plants grown in a dry soil failed to react to the addition of moisture at blooming time as healthy plants do. Plenty of soil moisture throughout podding time is necessary to secure even a comparatively good yield from such plants.

Jagger (I. C.). **Immunity to mildew (Bremia lactucae Reg.) and its inheritance in Lettuce.**—Abs. in *Phytopath.*, xiv, 2, p. 122, 1924.

Eight varieties of lettuce have been found which seem entirely immune from mildew (*Bremia lactucae*) in California and Florida. These appear, however, to be European kinds unsuited to American conditions. Hybridizations of immune with susceptible varieties gave all immunes in the F_1 generation and immunes and susceptibles in the ratio of 3 : 1 in the F_2. Immunity therefore seems to be a simple Mendelian dominant factor, and it is expected that immune strains of varieties of lettuce suitable to the local conditions can be bred.

Smith (R. E.) & Smith (Elizabeth H.). **Bacterial slime disease of Lettuce.**—Abs. in *Phytopath.*, xiv, 2, p. 122, 1924.

When lettuce is grown in California for eastern and local shipment, serious losses are caused by a disease characterized mainly by a tip and edge burn of the leaves, running down into a slimy rot of the head. The symptoms appear when the heads are just beginning to form, and reach the maximum development at the maturity of the crops. The trouble is of bacterial nature, but the etiology has not been determined. Infection is favoured by warm humid weather. The 'Los Angeles' variety is most susceptible, 'Big Boston' and 'Ice Berg' less so.

Fromme (F. O.). **The rust of Cowpeas.**—*Phytopath.*, xiv, 2, pp. 67–79, 1 pl., 1 fig., 1924.

The rust of the cowpea has commonly been identified as *Uromyces appendiculatus*, but the author presents evidence that it is a morphologically distinct species which he assigns to *U. vignae* Barclay. A new description of the species is given, the name being changed to *Nigredo vignae* in accordance with Arthur's classification. It differs from *U. appendiculatus* in the super-equatorial position of the germ pores of the uredospores, in the non-resting type of teleutospore, and in the aecidia being arranged in the usual annulate groups instead of in crosses or rosettes. A full

synonymy of the fungus is cited and from a study of herbarium material it is recorded on *Vigna repens*, *V. sesquipedalis*, *V. sinensis*, *V. vexillata*, *Dolichos lablab*, and *Phaseolus truxillensis*. In geographical distribution it is cosmopolitan and occurs practically co-extensively with its hosts.

Infection studies with uredospores from Blackeye cowpea on 18 varieties of cowpea and 19 varieties of kidney bean resulted in vigorous infection only on the Blackeye variety. Slight infection was found on four strains of the Blackeye type, but none occurred on any of the beans. Further, rust broke out in a variety test of 9 varieties of cowpea in 1921, but only Blackeye was affected. Inoculations on various other kinds of bean were uniformly unsuccessful. It is apparent therefore that the rust is closely limited in its host range.

U. vignae has produced aecidia in the field and in the greenhouse from inoculations with teleutospores, this behaviour being in marked contrast to *U. appendiculatus*, which rarely produces aecidia and did not do so during seven years experimentation with this fungus.

MAUBLANC (A.). **Les maladies de l'Arachide.** [The diseases of the Groundnut.]—*Agron. Colon.*, x, 73, pp. 1–12, 1 fig., 1924.

The ground nut (*Arachis hypogaea*) represents a very important crop in the French colonies, especially in West Africa, and the author has compiled a list of the most important diseases affecting this plant in various parts of the world. These are briefly described.

He states that up to the present no serious outbreak of disease has been reported from the French colonies, possibly owing to lack of definite information on the subject. The most widely distributed disease is stated to be the leaf spot caused by *Cercospora personata*, while rust (*Uredo arachidis*) is dangerous but, so far, confined to America. Other diseases mentioned are root rot (*Rhizoctonia* spp.); *Sclerotium* disease (*S. rolfsii*); bacterial rot (*Bacterium solanacearum*); and various little-known troubles, including an apparently physiological disease [curl or rosette: see this *Review*, iii, p. 500] which has caused some damage in Tanganyika.

BECKWITH (ANGIE M.). **The life history of the Grape rootrot fungus Roesleria hypogaea Thüm. et Pass.**—*Journ. Agric. Res.*, xxvii, 8, pp. 609–616, 1 pl., 1924.

A comparative study has been made of the grape root rot fungus *Roesleria hypogaea*, the lichen *Calicium pallidum* (*Coniocybe pallida*), and a non-ascogenous organism, *Pilacre faginea* (*P. petersii*), the identity of which is stated to be frequently confused owing to the similarity of their fruit bodies.

Previous investigators [references to whose work are given] differ in their opinion as to the parasitic or saprophytic nature of *R. hypogaea*, which occurs on a number of fruit and other trees besides the vine. The results of the author's experiments showed that when ascospores from pure cultures are sown in wounds the fungus can establish itself in living roots.

The cultural characters of *R. hypogaea* from apple roots are described. The mycelium is of a characteristic malachite-green colour.

Ascocarps were formed readily in the refrigerator, especially on autoclaved apple roots. The strain from apple root rot is evidently identical with that on grape, the inoculation of the latter with the apple strain resulting in the formation of similar ascocarps.

No conidial stage ever appeared in the life-cycle of *R. hypogaea*, which the author repeatedly grew to maturity in single ascospore cultures, whereas conidia were abundantly produced in cultures of *P. petersii*, which is considered to belong to the Basidiomycetes. The suggestion of Bayliss-Elliott and Grove (*Ann. Bot.*, xxx, p. 407, 1916), that the conidiophorous fungus *Pilacre* is a stage of the Discomycete *Roesleria*, is not accepted.

There is also stated to be no justification for the identification of *C. pallidum* with the apple and grape root rot organism.

QUINN (D. G.). **Downy mildew (Plasmopara viticola.)**—*Journ. Dept. of Agric. S. Australia*, xxvii, 6, pp. 540–550, 3 figs, 1924.

A brief historical review and a description of the symptoms, life-history, and treatment of downy mildew of the vine (*Plasmopara viticola*) are given. Under South Australian conditions the disease has so far failed to produce very serious effects, probably owing to the hot, dry summers normally experienced. The necessary combination of heat and moisture frequently occurs, however, about the middle of October, and at any time the mildew may appear in an epidemic form. Strong winds, either hot or cold, have been found to check its spread, so that exposed vineyards are much less liable to damage than sheltered ones. In Victoria and New South Wales no variety appears to be immune. The tractor sprayer has given better results in trellised vineyards than where the vines are pruned on the 'gooseberry bush' system.

Directions are given for the preparation and application of Bordeaux and Burgundy mixtures, the latter being regarded as quite equal in general efficacy to the former and possessing certain advantages which are briefly enumerated. There is, however, danger of burning when Burgundy mixture is applied late in the season, and Bordeaux is therefore recommended for use against this disease as well as against others that necessitate spraying when the plant is in leaf.

SOUTH (F. W.) & BIRKINSHAW (F.). **Summary of the work of the inspection division for the first three quarters of 1923.** —*Malayan Agric. Journ.*, xii, 2, pp. 32–50, 1924.

The following references of phytopathological interest are contained in this Report. Mouldy rot of *Hevea* rubber (*Sphaeronema fimbriatum*) continues to spread, and further evidence has been obtained of the conveyance of the disease by human agency. Stringent measures [which are briefly described] are being taken to secure the execution of the prescribed control operations.

During the wet weather in January, reports were received from Selangor of damage caused to the renewing bark of *Hevea* trees by a fungus with a flat, white, fan-shaped mycelium. The whole surface of the renewing bark is gradually penetrated and killed. The fungus, which is readily controlled by agrisol and water, or

brunolinum, tar, and water, is believed to be a species of *Cyphella*, but no fructifications have yet been found.

Fomes lignosus is stated to have gained a firm hold on many rubber estates in Johore owing to lack of treatment in the early stages, and its eradication now presents serious difficulties.

A die-back of cloves [*Eugenia caryophyllata*] caused considerable damage to the older trees on Penang Island and elsewhere. It is commonly associated with the presence of borers in the branches.

The attacks of *Brachartona catoxantha* on coco-nut [see this *Review*, i, p. 332] have been greatly minimized owing to the heavy parasitization of the insect by *Botrytis* [*necans* Massee].

Nejdůležitějši choroby a škůdcové kulturních rostlin v Čechach r. 1923. Zpráva stát. výzkumných ústavů pro výrobu rostlinnou (ústavu fytopathologického) v Praze. [The principal diseases and pests of cultivated plants in Bohemia in 1923. Information from the State Agricultural Research Office (Phytopathological Office) in Prague.]—*Ochrana Rostlin*, iv, 2–3, pp. 44–45, 1924.

The following items from this survey are of special interest. Considerable frosts and heavy snowfalls during the winter of 1923 brought about a very heavy outbreak of *Fusarium nivale* on rye, especially on exposed heights or in very low-lying places ; in many cases as much as 90 per cent. of the crop was destroyed by the disease. The year was furthermore marked by almost general epidemics of rusts, especially of *Puccinia glumarum* and *P. triticina*, which destroyed from 50 to 100 per cent. of the wheat crop. Wheat also suffered heavily from *Tilletia tritici*, *Ophiobolus herpotrichus*, and *Cladosporium herbarum*, the last-named having, in two localities, totally ruined the crop. Heavy losses were likewise caused in many cases by *Puccinia lolii*, *P. graminis*, and *Ustilago levis* on oats, *P. graminis* and *Helminthosporium gramineum* on barley, and *Urocystis occulta* on rye.

The principal diseases of sugar beets during the year were heart rot [see this *Review*, ii, p. 466], *Peronospora schachtii*, and *Cercospora beticola*, while in some localities beetroot seedlings suffered heavily from blight and from *Typhula betae*.

The most widespread potato disease was bacterial blackleg [*Bacillus atrosepticus*], which in some fields attacked up to 70 per cent. of the plants. Potato blight (*Phytophthora infestans*) was also recorded in many places and some losses were caused by *Sporidesmium solani varians* [*Alternaria solani*]. Other diseases recorded were *Rhizoctonia solani*, leaf curl, leaf roll, and an undetermined scurfiness of the tubers. A new focus of wart disease was found in the district of Sluknov [see below, p. 601]. Stored potatoes suffered heavily from bacterial, *Phytophthora*, and *Fusarium* rots.

McRae (W.). **Economic Botany. Part III. Mycology.**—*Ann. Rept. Board Scientific Advice, India, 1922–23*, pp. 31–35, 1924.

In addition to various items already noticed in this *Review* from other sources, the Report contains the following references of phytopathological interest.

Under Madras conditions spores of *Vermicularia curcumae* were found to be viable after seven months and capable of infecting cabbage, brinjal [*Solanum melongena*], *Datura*, knolkohl, and *Withania somnifera*. Sclerotial masses capable of germination up to two years after formation were found on and near the scaly leaves of the rhizomes of turmeric and are believed to be instrumental in the spread of the disease. The species of *Vermicularia* on cabbage was also able to infect chillies [*Capsicum annuum*], brinjal, ginger, and *Datura*, while those on Bengal gram (*Cicer arietinum*) and vegetable marrow are under investigation.

Among new varieties of sugar-cane, 15 hybrids between Kassoer and D 74 and 9 between Kassoer and Fiji B have so far proved resistant to smut [*Ustilago sacchari*].

Soil infected with oospores of *Sclerospora graminicola*, the cause of leaf shredding of *Andropogon sorghum*, produced a crop of diseased plants, thereby indicating the method of transmission.

The species of *Rhizoctonia* and *Gloeosporium* on *Carica papaya* are being investigated; the latter fungus is effectively checked by spraying with Bordeaux mixture. *Gloeosporium* on mango and species of *Cercospora* on safflower [*Carthamus tinctorius*], fenugreek [*Trigonella foenum-graecum*], eggplant, pomegranate, and *Solanum nigrum* have been studied.

In the areca palm [*Areca catechu*] gardens on the west coast, coco-nut trees affected by nut fall were found to be attacked by *Phytophthora arecae*, the cause of decay of areca nuts. Inoculation experiments with pure cultures produced the same symptoms. Attempts are being made to prevent the disease by spraying both hosts simultaneously.

Further experiments on varietal resistance to cotton wilt [*Fusarium* sp.: see this *Review*, i, p. 292] were conducted in Bombay, inoculations being made both in the field and in pots. Of 431 plants of Wagale, 4 per cent. were wilted, of 414 plants of Dharwar 2, 30 per cent., and of 419 plants of Kumta, 39 per cent. The incidence of disease in the other varieties tested ranged from 56 to 83 per cent. In the F_1 generation of a cross between Dharwar 1 and a pure wilt-resistant strain of Wagale, resistance was found to be dominant, at any rate during the greater part of the growing period. The results of pot experiments showed that the variety Broach Deshi Plant 6 is completely immune from wilt.

A leaf spot and blight of onions was shown by inoculation experiments to be caused by a species of *Alternaria* which is a wound parasite. The disease was found to be dependent on high temperature and humidity. The Goa and Nandore varieties showed considerable resistance. Small doses of sodium nitrate applied at intervals gave beneficial results.

A study of the mango inflorescence blight has shown that a member of the Erysiphaceae is involved as well as the leaf-hoppers constantly associated with the disease; in some cases it is probably the sole cause of the blight.

Data are being collected on the diseases grouped under the term mosaic, of which examples are found in Bombay on cardamoms [*Elettaria cardamomum*], chillies, tobacco, potato, tomato, and *Raphanus sativus* var. *caudatus*.

A disease of wheat associated with an *Alternaria* and one of the betel vine [*Piper betle*] connected with a *Fusarium* have been investigated.

The results of several years' field experiments have shown that smut of *Eleusine coracana* (*Ustilago eleusinis*) is not seed-borne, and consequently that seed disinfection with copper sulphate is useless.

Different treatments for the control of jowar [sorghum] smut [*Sphacelotheca sorghi*] were tested in the Central Provinces. Copper carbonate dust, lime-sulphur, and flowers of sulphur were all efficacious, especially the first named, copper sulphate solution also giving good results. Formalin proved very inferior.

Negative results were obtained in the Central Provinces from inoculation experiments on healthy cotton plants with cultures of species of *Fusarium* and *Cephalosporium* isolated from wilted stems and roots.

Report of the Agricultural Department, Bengal, for 1922–23.— pp. 1–17, 1924.

The following references of phytopathological interest are contained in this Report.

The incidence of *Rhizoctonia* on jute (*Corchorus* spp.) was only 5 per cent. during the period under review as compared with 25 per cent. in the previous year. Chemical investigations have demonstrated a connexion between the occurrence of jute disease and the amount of plant food available.

A serious fungous disease of areca palms is under investigation, so far without definite results.

Betel vines [*Piper betle*] are also attacked by a fungous disease believed to be associated with the cultivation of this essentially upland crop in low, water-logged soils. Spraying with Bordeaux mixture has given good results.

Work has been carried out in connexion with bud rot [*Phytophthora palmivora*] of Palmyra palm [*Borassus flabellifer*] in the Hooghly and Burdwan districts.

Plant diseases.—*Thirty-sixth Ann. Rept. South Carolina Exper. Stat. for the year ended June 20, 1923*, pp. 46–48, 1924.

Certain phases of the cotton anthracnose [*Colletotrichum gossypii*] problem are still under investigation. As a result of the measures already evolved for the control of this and other cotton diseases (e.g., wilt [*Fusarium vasinfectum*] and leaf spot [*Bacterium malvacearum*]), South Carolina growers are stated to be saving thousands of dollars per annum.

Two new diseases encountered in 1922 are under observation, namely, a bacterial affection of English peas, which is stated to be causing severe damage, and a disease of mung beans [*Phaseolus mungo*].

During 1923 a new stem blight of snap beans, which caused the loss of the entire crop within a few weeks, was discovered and is being closely investigated.

Anthracnose of watermelons [*Colletotrichum lagenarium*] was

extremely destructive in the south-east of the State. Good control was assured by timely applications of Bordeaux mixture.

Black rot and anthracnose of the vine [*Guignardia bidwellii* and *Gloeosporium ampelophagum*] caused heavy losses.

Diplodia boll rot of cotton [*D. gossypina*] was responsible for serious reductions (up to 30 to 40 per cent.) of the crops in the central and eastern districts of the State after heavy rains during the latter part of August.

Downy mildew of cantaloupes and cucumbers [*Pseudoperonospora cubensis*] was prevalent, but yielded readily to treatment with Bordeaux mixture.

WILSON (J. K.). **Bacterial symbiosis in plants other than the legumes.**—*Journ. Amer. Soc. Agron.*, xvi, 6, pp. 373–381, 1924.

The work of various investigators [which is briefly summarized in the present paper] has led the author to the following conclusions. Bacteria are present in the buds, flowers, and seeds, as well as in other parts, of a large number of plants. In certain cases the bacteria are transmitted in the seed, and this condition, for which the term 'hereditary symbiosis' is proposed, has been observed in the Myrsinaceae and Rubiaceae [see this *Review*, ii, p. 418, and iii, p. 358]. It is believed to occur also in many other families. Members of both the families named, when deprived of their bacterial symbionts and grown in a substratum deficient in nitrogen, show signs of nitrogen starvation.

BROWN (NELLIE A.). **An Apple stem-tumor not crown-gall.**—*Journ. Agric. Res.*, xxvii, 9, pp. 695–698, 3 pl., 1924.

The type of apple-tree deformity referred to in the present paper as a stem tumour is an outgrowth with masses of root-like projections or, on some varieties, with a nearly or entirely smooth surface. The excrescences vary in size from small warts to tumours 2 to 6 inches in diameter, and in macroscopic characters resemble those produced by artificial inoculations with pure cultures of *Bacterium tumefaciens*. The so-called aerial crown gall, however, is seldom, if ever, caused by this organism under natural conditions. None of the tumours examined from different parts of the United States contained *Bact. tumefaciens*, although absolutely fresh, young material was used for making isolations, the old tumours being unsuitable on account of their dry, hard condition.

ARRHENIUS (O.). **Försök till bekämpande av havrens gråfläcksjuka. II. Kärl och fältförsök.** [Experiments in the control of grey speck of Oats. II. Pot and field tests.]—*Kungl. Landtbr. Akad. Handl. och Tidskr.*, lxiii, 2, pp. 192–209, 1 col. pl. [in No. 3], 1 map, 1924.

In continuation of his previous investigations on the control of grey speck of oats [see this *Review*, iii, p. 24], the author made further studies, the results of which bore out his earlier conclusions.

In pot tests, the best yields were given by the plants receiving potassium permanganate, ammonium sulphate, and ammonium

chloride at the rate of 550, 200, and 180 kg. per hect. respectively, and the incidence of the disease was also somewhat reduced by these treatments. Manganese sulphate gave complete control and also resulted in a satisfactory yield. Sodium and potassium sulphate gave a slight increase in yield, the former also reducing the percentage of infection. The nitrates again exercised an adverse effect.

It was shown in field experiments that the application of stable manure considerably reduced the incidence of grey speck.

A number of preliminary tests indicate that the remedial treatment of the disease is in general less satisfactory than the prophylactic, unless given at very early stages.

Barley and wheat may also be affected by grey speck, while heart rot of sugar beet [see this *Review*, ii, p. 484] and the calcifuge habit of flax and lupins [see this *Review*, i, p. 445] are believed to be attributable to an allied cause.

Ammonium sulphate is stated to be cheaper in Sweden than manganese (which has to be imported, chiefly from Germany), and has the additional advantage of serving as an ordinary nitrogenous fertilizer.

WEISS (F.). **The effect of rust infection upon the water requirement of Wheat.**—*Journ. Agric. Res.*, xxvii, 2, pp. 107–118, 1924.

Experiments are recorded in this paper dealing with the effect of the stem and leaf rusts (*Puccinia graminis tritici* and *P. triticina*) on the water requirement of Marquis wheat plants, and the effect of mineral nutrition on the development of the rusts. The plants were grown singly in crocks filled with quartz sand having a moisture equivalent of 3 per cent. and maximum water capacity of about 12 per cent. The soil moisture content was maintained by weighing the crocks at 7, or later 3, day intervals and adding water to restore the weight. Mineral nutrients were supplied using a basic solution of $Ca(NO_3)_2$, KH_2PO_4, $MgSO_4$ in gram molecular proportions, with the addition of ferric phosphate (5 c.c. in 1 l.), and adding nitrogen as NO_3, phosphorus as PO_4, and potassium as chloride to form six modified solutions. The quantity of rust was estimated at heading time. Leaf rust infection was secured by spraying the plants with a suspension of uredospores, but for stem rust the leaves were moistened, dry uredospores applied, and the atmosphere kept moist by allowing steam to escape into the house for 48 hours, a process which was repeated at monthly intervals.

Infection by either rust resulted in a significant reduction of yield (dry weight) of tops and grain, which in the case of stem rust may amount to 20 per cent. with a 30 per cent. infection. At the same time, however, there is practically as much water required as in healthy plants (6,444 c.c. for stem rust, 6,154 c.c. for leaf rust, and 6,679 c.c. for control); that is, rusted plants have a higher water requirement (based on yield of both tops and grain), but this was only significant in the case of stem rust.

The data obtained on the influence of certain mineral nutrients on the development of rust and injury to host were too limited to indicate more than mere tendencies. The addition of NaCl or

NaH_2PO_4 to the basic three-salt nutrient solution did not affect the susceptibility to rust. Excess nitrate (as $NaNO_3$) resulted in greater susceptibility both as regards the number and size of the pustules, but the more luxuriant development of culms and more rapid growth of the plants seem sufficient to account for the greater development of rust, and the assumption of a physiologically greater susceptibility to rust is unnecessary. Infection was retarded by KCl in proportion to the diminution in the growth of the host, particularly when used in excess. $CaCl_2$ and $MgCl_2$ induced a slight development of rust, an effect which cannot be attributed to poor growth, but the plants apparently were somewhat physiologically resistant. $CaCl_2$ also resulted in a reduction of water requirement, about 10 per cent. for the tops and 40 per cent. for the grain.

STAKMAN (E. C.) & AAMODT (O. S.). **The effect of fertilizers on the development of stem rust of Wheat.**—*Journ. Agric. Res.*, xxvii, 6, pp. 341-379, 3 pl., 4 figs., 1924.

The present paper gives a rather detailed account of an eight years' investigation on the direct or indirect effect of natural and artificial fertilizers on the susceptibilty and resistance of wheat to *Puccinia graminis* and *P. triticina.* The work comprised both field observations and experiments in which the varieties of wheat tested were grown on several types of soil in different parts of Minnesota, either under artificially induced or natural epidemics. The artificial fertilizers used were acid phosphate, sodium nitrate, and potassium chloride or sulphate; they were applied either singly in varying amounts per acre, or combinations were made between acid phosphate and one of the other fertilizers; on the poorer soils a complete fertilizer was also used. In addition, experiments were made with farmyard manure in combination with other fertilizers, and some trial plots were established on cabbage, clover, and lucerne soils.

With respect to stem rust (*Puccinia graminis*) the results indicate that the degree of physiological resistance or susceptibility of the varieties of wheat tested was not directly influenced by the different fertilizers employed. Morphological resistance, however, may be slightly modified, as the fertilizers appear to have a direct influence on the growth and yield of the plants. Thus, an excess of nitrogenous manure, on some soils and under certain weather conditions, increased the density of the stands and delayed the maturation of the plants, so rendering conditions for infection more favourable and lengthening the time during which the plants could contract the disease, with the result that wheat on such plots appeared to be more heavily attacked by rust than on other plots. The yields were considerably reduced by the increase of the proportion of straw to grain and by a greater disposition of the plants to lodge and to ripen prematurely, a result which has probably been confused with rust injury. The harmful effects of excessive nitrogenous fertilization were not counteracted either by acid phosphate or by potassium. On soils deficient in nitrogen, farmyard manure and nitrates increased the yield without increasing

the severity of attack by stem rust, and on properly fertilized soil the wheat yielded well in spite of heavy infection.

In regard to the orange leaf rust (*P. triticina*) there was some evidence that fertilization with sodium nitrate increased the development of the rust, while phosphorus and potassium showed some tendency to prevent its development.

A bibliography of 41 titles is appended.

HURSH (C. R.). **Morphological and physiological studies on the resistance of Wheat to Puccinia graminis tritici Erikss. & Henn.**—*Journ. Agric. Res.*, xxvii, 6, pp. 381–411, 2 pl., 1 fig., 1924.

After a summary of the existing literature on the resistance of wheat to rust, the author details his own experiments on *Puccinia graminis tritici* with respect to (1) the entrance of the germ-tubes into the host; (2) the morphology and the physico-chemical properties of the wheat plant as related to rust resistance; and (3) the influence of various nutrient salts on the development of the disease.

Accurate counts and measurements indicated that neither the number of hairs on the leaves nor the size and number of stomata in the susceptible and resistant varieties of wheat studied have any important influence on the entrance of the germ-tubes, although under unfavourable conditions the large number of hairs on some varieties may help to reduce the number of infections. Infection is probably affected to a much greater degree by the movements of the stomata, for if these remain closed, there is no evidence that the germ-tubes can force their way between them. There are indications that the stomatal movements in different varieties of wheat are affected differently by environmental conditions.

The mycelium of *P. graminis* is limited almost entirely to chlorenchymatous tissue, and extensive studies on different varieties of wheat showed that in some resistant varieties the sclerenchyma had developed to such an extent that the collenchyma was confined to small bundles, thus limiting the development of the mycelium to these relatively small areas. In such varieties the uredosori are likely to be narrowly linear, while in the varieties with a large amount of collenchyma in the stems, large uredosori are likely to be produced. It was also shown that the ratio of sclerenchyma to collenchyma can be reduced by excessive fertilization with nitrogen. The effect of the latter, especially when not counterbalanced by the addition of other fertilizers, is probably to increase the area in which the fungus can live, and thus render the wheat more liable to damage by rust. Phosphate and potassium fertilizers appear, on the other hand, to increase the amount of sclerenchyma. An explanation of the greater susceptibility of seedlings of some varieties than older plants to certain biologic forms of *P. graminis* is probably due to the greater amount of sclerenchyma in the mature plants than in the seedlings.

Differences were also found in the physico-chemical properties of the sap of susceptible and resistant wheat varieties, but no definite correlation could be established between these properties and resistance to rust. The differences in the reaction of wheat varieties

to different biologic forms of *P. graminis tritici* appear to be due entirely to physiological causes.

A bibliography of 59 titles is appended.

GRIFFITHS (MARION A.). **Experiments with flag smut of Wheat and the causal fungus, Urocystis tritici Kcke.**—*Journ. Agric. Res.*, xxvii, 7, pp. 425–449, 3 pl., 1 graph, 1924.

Flag smut of wheat (*Urocystis tritici*) [see this *Review*, ii, p. 129] is known to occur in the United States, Australia, Japan, China, India, South Africa, Italy, and Spain. During the five years that the disease has been under observation in America the estimated annual loss in the infested area amounts to less than 2 per cent.

The fungus produces sori on the leaves, stalks, and glumes, and may prevent the plants from heading in severe cases. The spores do not germinate readily, but a fairly high percentage of germination was secured by the following methods. Spore-laden leaves were reduced to powder and floated, in the form of a fine dust, on distilled water in a watch glass at a temperature of 18° to 20° C. Germination began in two to three days and proceeded rapidly from the fourth day onwards, elongated sporidia being present in abundance on the fifth day. Fairly good germination was also secured in diluted juice expressed from wheat seedlings, while in some cases germinating seeds, placed on soil in a Petri dish, also proved a stimulating medium.

Inoculation tests indicated that the infective power of the spores is not destroyed even though they are stored two or three years under laboratory conditions, whilst after four years good germination of the spores was obtained. In an experiment to test the comparative efficacy of freshly collected and dry spores in the causation of infection, the former produced only 5·7 and the latter 47 per cent. of infections.

It was shown by a series of experiments, in which the spores were buried in the soil for varying periods during the autumn and winter months, that viability, though reduced (especially during November and February), was still sufficient, after a winter and subsequent summer in the flag smut area of Missouri, to produce a certain amount of infection.

Sowing inoculated wheat at successive dates in the autumn resulted in a general decrease of the percentage of infection, none occurring in the crop sown on 14th November or later. Infection took place between 6° and 23·5° C., the optimum being 21·5° to 23·5°; none occurred above 25°. The most favourable stage of development of the host plant for infection was before the rupture of the coleoptile and the emergence of the seedlings from the soil.

Seventeen winter and 11 spring varieties of different degrees of susceptibility were studied to ascertain the effect of cutting back the plants to a few inches in height on the appearance of infection. In 5 spring and 3 winter varieties it was found that infection occurred either earlier or more severely as the result of such treatment. The same effect was produced by continued watering after maturity, an increase of 73·3 per cent. infection resulting on

account of smut sori appearing on the small secondary shoots which developed.

These data are regarded as indicating that resistance in some cases may be more apparent than real, the fungus being present in the plant tissue even though sporulation be precluded. Such varieties would not, of course, be suitable for breeding purposes.

The Fulcaster, Poole, Red May, Red Rock, Early Defiance, and Galgalos varieties remained free from smut during the three years covered by the investigations, while Illini Chief, Turkey, Treadwell, and Peliss, grown only for two years, were also immune. Susceptible varieties showed much higher percentages of infection in the greenhouse than in the field.

Noble (R. J.). **Studies on the parasitism of Urocystis tritici Koern., the organism causing flag smut of Wheat.**—*Journ. Agric. Res.*, xxvii, 7, pp. 451–489, 3 pl., 2 figs., 1924.

Flag smut of wheat (*Urocystis tritici*) [see preceding abstract] is stated to cause an average annual loss of 3 per cent. of the wheat crop in Australia, although up to 70 per cent. of infection has been observed.

The lesions may appear on plants in any stage of growth up to heading. The earliest recorded spots were observed on the fifth leaf of a wheat plant 29 days after inoculation; in other cases the fourth leaf was first affected. Under greenhouse conditions the first formed culms of partially infected plants were often free from disease.

Fresh spores did not germinate except after drying for 48 hours over concentrated sulphuric acid. Uninjured seedlings of non-susceptible plants stimulated the germination of spores presoaked in water, and such a phenomenon may be expected to occur in the field.

The most favourable medium for the germination of presoaked spores was the expressed sap of wheat seedlings at a concentration of 1 part per 10,000. In solid media the germ-tubes of *U. tritici* grew to a length of 4 mm.

Surface films of benzaldehyde (3 to 2,000,000 of water), salicylaldehyde, butyric acid (1 part to 500,000), and acetone strongly stimulated the germination of presoaked spores. Presoaking the spores seemed to result in increased permeability of the spore sheath, thereby facilitating more rapid ingress of the volatile stimulant. The stimulatory action of the above-mentioned substances was not correlated with any definite reduction of the surface tension of the medium as measured against air, and is believed to be due mainly to the permeability which they produce in the protoplasmic content of the spores. Preliminary tests indicate that films of certain volatile materials also stimulate the germination of the teleutospores of *Puccinia graminis tritici* and the spores of *Colletotrichum lindemuthianum* and *Urocystis occulta*. Under the conditions of the author's experiments the spores of flag smut germinated within a hydrogen-ion range of P_H 3·6 to 7·1, the optimum occurring at P_H 5·1 to 5·7. The relative humidity to which the spores are exposed markedly affects their viability; 50 to 70 per cent. was the most favourable range. At such humidities

and within a temperature range of 5° to 26·5° the spores frequently began to germinate shortly after being placed in distilled water, without the addition of a stimulatory agent.

Wheat seedlings with coleoptiles more than 4 mm. long did not become infected when inoculated with dry spores. Inoculations even with a few germinating spores at suitable temperatures consistently resulted in heavy infections, whereas large numbers of dry spores frequently gave negative results.

Soil temperatures from 14° to 21° C. were best for infection of wheat seedlings by *U. tritici*, the earliest and most severe infection occurring at 19° to 21°. Some plants became infected at 23° to 25°, but no disease occurred at 29° to 31°. Inoculation at 15° and subsequent transfer of the plants to temperatures above 23° resulted in a decrease in the amount of infection. Some plants became infected at 5°.

The spore nucleus was found to divide at germination, the nuclei migrating to the promycelium and a single nucleus usually passing into each sporidium. When the latter germinates, the nucleus divides, the germ-tube becoming binucleate and sometimes remaining so for a considerable period. Sporidial conjugation was sometimes observed, resulting in the production of a single germ-tube containing the two nuclei which migrated from the sporidia.

The mycelium within the plant is typically intercellular, haustorium-like bodies having sometimes been observed. Branching and fusion of the hyphae occur within the plant. Prior to spore formation, binucleate hyphal cells were observed. While some spores appear to arise from a single hypha, two distinct hyphae are frequently involved. Sterile cells and spores arose simultaneously from single coiled structures, differentiation of the cells occurring as development proceeded.

Infection hyphae of *U. tritici* were observed to enter the tissues of rye seedlings known to be immune from flag smut.

RICHARDSON (A. E. V.). **Treatment of Wheat for smut.**—*Journ. Dept. Agric., Victoria*, xxii, 4, pp. 224–230, 1924.

For the past four years experiments have been conducted by the Victoria Department of Agriculture to ascertain the relative efficacy of dry copper carbonate and the standard treatments for the control of bunt of wheat (*Tilletia tritici*).

Seed wheat heavily infected with spores was (1) soaked in water for 3 minutes; (2) immersed for 3 minutes in 2 per cent. (or 1·5 per cent. in 1921–23) copper sulphate; (3) immersed for 3 minutes in formalin 1 in 400 (1 in 450 in 1921–23); (4) treated with powdered copper carbonate 2 oz. per bush.; (5) treated with powdered copper sulphate 2 oz. per bush. A comparison of the results shows the superiority of the two dusts, especially copper carbonate, as regards germination, freedom from disease, and yield, to any of the other treatments. They were particularly efficacious where sowing was delayed for a fortnight and where the seed was re-infected before sowing. Copper sulphate solution and formalin proved fairly satisfactory when sowing was carried out immediately after treatment, but any delay resulted in a serious loss of vitality and reduction of yield, particularly in the case of formalin.

Imported copper carbonate of the requisite standard may be obtained at a cost of 1*s.* 6*d.* per lb., and it is stated that the benefits gained by using dusts easily compensate for the high cost of the material.

SÉVEGRAND (P.). **Le piétin des céréales.** [Foot rot of cereals.]—*La Vie agric. et rurale*, xxiv, 22, pp. 341–342, 1924.

The symptoms of cereal foot rot (stated to be due to *Ophiobolus graminis* and *Leptosphaeria herpotrichoides*) are briefly described. The disease has been observed to occur especially in damp clay soil, in heavily shaded areas, and in crops following clover, lucerne, or potatoes. Nitrogenous manures are stated to predispose the plants to foot rot, while phosphates, potassium, and lime enable them to resist the attack. Phosphates should be given at the time of sowing, since delayed applications result, as with nitrogen, in a sudden spurt of vegetation which favours the disease. Dense, broadcast, and premature sowing should be avoided. Early varieties are stated to be more susceptible to foot rot than the late or so-called 'native' sorts. Good control may be ensured by treatment with sulphuric acid [see this *Review*, ii, p. 11] and by maintaining the fields in a state of thorough cultivation.

FLOYD (W. L.). **Citrus insects and diseases in Florida.**—*Amer. Fruit Grower*, xliv, 2, pp. 16, 35, 42–43, 5 figs., 1924.

An account is given of the entomogenous fungi of the Florida citrus groves [see this *Review*, ii, p. 369]. The white fly [*Dialeurodes citri*] is attacked by five species, at least three of which effectively help to hold it in check, namely, the red fungus [*Aschersonia aleurodis*], the yellow fungus [*A. flavocitrina*], and the brown fungus [*Aegerita webberi*]. Purple and long scale [*Lepidosaphes beckii* and *L. gloveri*] are attacked by the red-headed fungus [*Sphaerostilbe coccophila*], the grey-headed fungus [*Ophionectria coccicola*], and the black fungus [*Myriangium duriaei*], and the Florida red scale [*Chrysomphalus aonidium*] by the pink fungus [*Microcera fujikuroi*].

Various methods of disseminating the fungi in infected orchards have been tried. That most extensively practised at present consists in soaking leaves well covered with fruiting fungi in water, stirring thoroughly, and then spraying the solution on infested trees. This should be done during the rainy season, with a mixture of two or more fungi. The leaves and attached fungi may be gathered in the autumn and kept in cold storage till required. The red fungus can be cultivated on sweet potatoes. During the last few years over 2,000,000 trees have been treated annually by these methods.

Cotton production in 1924. Recommendations of Association of Southern Agricultural Workers.—*Amer. Fertilizer*, lx, 2, pp. 21–22, 1924.

The following recommendations, *inter alia*, were adopted by the cotton council of the Association of Southern Agricultural Workers. In soil infected with the cotton wilt fungus [*Fusarium vasinfectum*] good seed of the highly resistant varieties Dixie Triumph, Toole,

and Lewis 63 should be planted. Where root knot [*Heterodera radicicola*] and wilt are both present a three-year rotation (which may include maize, small grains, peanuts, velvet beans, and Brabham or iron cowpeas) should be practised, followed by the cultivation of wilt-resistant varieties. A two-year rotation and the use of disease-free seed are recommended for the control of anthracnose [*Glomerella gossypii*]; and delinting the seed with sulphuric acid for that of angular leaf spot, black arm, and bacterial boll rot [all caused by *Bacterium malvacearum*].

PRETI (G.). **Intorno ad una malattia del 'Chrysanthemum frutescens' Tumb.** [Concerning a disease of *Chrysanthemum frutescens* Tumb.]—*Riv. Patol. Veg.*, xiv, 1–2, pp. 6–12, 1924.

In the spring of 1923 numerous plants of *Chrysanthemum frutescens* in the Portici Botanic Gardens [Naples] were attacked by a disease affecting the inflorescences and foliage, the former assuming an intensely chlorotic and finally scorched appearance and the latter exhibiting a more varied range of symptoms, including yellow to dark brown spotting and a phosphorescent decay of the upper surface.

Microscopic examination revealed the presence of a brown mycelium bearing a conidial stage closely resembling *Cladosporium macrocarpum* or *C. obtectum*. After a spell of rainy weather in October very dark brown, spherical, depressed, ostiolate perithecia were found, which were almost identical with, but slightly smaller than, those of *Pleospora herbarum*. Finally numerous pycnidia of *Phoma herbarum* were detected on the dry stalks.

Culture experiments on decoction agar and *Chrysanthemum* leaves were undertaken with material from all three stages. The spores of *Pleospora* developed abundant conidia of a *Macrosporium* type, followed by fructifications resembling those of *Cephalosporium*, and finally (after 9 days) by the typical perithecia of *Pleospora*. The *Phoma* spores gave rise after 15 to 20 days to the characteristic pycnidial form, while the conidia of *Cladosporium* produced in 3 days fructifications resembling those of *Alternaria*. It was impossible, however, to obtain the *Pleospora* stage from the *Cladosporium* cultures.

This is believed to be the first record of *Cladosporium* on *Chrysanthemum*. Owing to the difficulty of defining the exact systematic position of the causal fungus without further study, the disease will provisionally be known merely as 'cladosporiosis'.

DOWSON (W. J.). **A flower-spike disease of cultivated Antirrhinums.**—*Gard. Chron.*, lxxv, 1936, p. 62, 1924.

Two varieties of antirrhinum, one white-flowered, the other with pale pink and yellow flowers, were attacked at Wisley [Surrey] in June 1922 by a disease which resulted in considerable damage to the flowers and failure to produce seeds. The blossoms were killed from the oldest flower upwards, and subsequently the stem died downwards, and the lateral branches became similarly affected.

Later in the season the black sclerotia of *Sclerotinia sclerotiorum* were discovered near the base of the stems and in the pith of

affected plants. Inoculation of healthy plants through the stem or stigma gave positive results.

In May 1923 small brown apothecia, $\frac{1}{8}$ to $\frac{1}{4}$ inch in diameter, developed from the sclerotia and emitted clouds of spores for about three weeks. These spores were transferred to the stigmas of antirrhinum plants with positive results. This is believed to be the first record of such a mode of infection by *S. sclerotiorum*. It is thought that under natural conditions bees and mites may be responsible for depositing the spores on the flowers.

It was found that the excision of the diseased portions of the plants before the development of the laterals resulted in the production of healthy flowers, and control measures should therefore be based on this practice, care being taken also to burn all infected material.

DOWSON (W. J.). **A sclerotial disease of Narcissus.**—*Gard. Chron.*, lxxv, 1943, p. 160, 1924.

A hitherto unrecorded disease of narcissus bulbs, characterized by the presence of rounded, flattened, black sclerotia, $\frac{1}{16}$ to $\frac{1}{8}$ inch in size, embedded in the partially decayed, fleshy scales, is under investigation at Wisley [Surrey]. In some cases the central immature flower and flower stalk are decayed and also contain sclerotia. After a few days in a warm, moist atmosphere, the sclerotia give rise to fructifications of the *Botrytis* type.

Brief reference is made to the similar diseases of tulips (caused by *B. parasitica*), snowdrops, and Spanish irises.

ESMARCH (F.). **Der Rosenmehltau und seine Bekämpfung.** [Rose mildew and its control.]—*Die kranke Pflanze*, i, 2, pp. 21–23, 1924.

The symptoms and life-history of rose mildew (*Sphaerotheca pannosa*) are described in popular language. The disease is stated to attack principally hothouse plants and those growing against south and south-east walls. Crimson Ramblers and other quickly maturing varieties with soft foliage are particularly susceptible.

Treatment consists of thorough cultivation; growing on clay soil if possible; the liberal application of manure; and dusting with finely ground sulphur or elosal, or spraying with 1 per cent. solbar or 0·5 to 1 in 1,000 cosan. The dusting should be repeated at 3- to 4-weekly intervals throughout the summer, and the spraying every 2 to 4 weeks during the same period.

CURREY (J. A.). **Bicarbonate of soda spray effective.**—*Amer. Rose Annual 1924*, pp. 69–70, 1924.

During 1922 and 1923 the writer used bicarbonate of soda (1 oz. per gall. water) for the control of mildew of roses [*Sphaerotheca pannosa*] with excellent results. The varieties treated were General MacArthur and Frau Karl Druschki. This preparation is stated to be the sole remedy for rose mildew used in Russia.

Cavara (F.). **Di una infezione crittogamica del Lupino. Mastigosporium lupini (Sor.) Cavara.** [A cryptogamic infection of the Lupin, *Mastigosporium lupini* (Sor.) Cavara.]—*Riv. Patol. Veg.*, xiv, 1–2, pp. 13–16, 1924.

Lupins (*Lupinus albus*) in the Naples Botanic Gardens were observed, during the wet and cold autumn and winter of 1923–24, to be suffering from a fungous disease involving a spotting, withering, and falling of the leaves.

The causal organism, which is evidently capable of withstanding a temperature of 5° to 6° below zero, was immediately recognizable by its large, flagellate spores, as a species of *Mastigosporium*, differing considerably in morphological characters from the only known species of this genus, *M. album*. The spores of the lupin fungus are 70 to 80 by 14 to 16 μ, with a long polar flagellum up to 90 μ and four shorter ones arranged crosswise in the terminal segment. They have 3, 4, or 5 septa, the two terminal cells being hyaline and the intermediate ones olivaceous and with a dense, granular protoplasm. They are readily detachable and carried by various agencies from one plant to another. The mycelium is partly superficial, but finally penetrates the mesophyll and induces a necrosis of the cells.

A comparison of the lupin *Mastigosporium* with Sorauer's *Pestalozzia lupini* (*Zeitschr. für Pflanzenkrankh.*, viii, p. 266, 1898) reveals the absolute identity of the two fungi, and the causal organism of the disease is therefore renamed *M. lupini* (Sor.) Cav.

Baudyš (E.). **Rakovina jetele.** [Clover canker].—*Ochrana Rostlin*, iii, 1–2, pp. 4–7, 1 fig., 1923. [Received 1924.]

In consequence of an exceptionally severe outbreak of *Sclerotinia trifoliorum* in the spring of 1923, a large number of clover fields in Moravia had to be ploughed in, while the majority of others had to be resown with some other fodder crop. The first serious symptoms appeared in March, when either individual plants or whole stands of clover were in a dying condition. For a detailed description of the disease the author refers to A. Kutin's pamphlet 'Houba *Sclerotinia trifoliorum* Erikss., obrovsky škůdce našich jetelů' [The fungus *Sclerotinia trifoliorum* Erikss., a great scourge of our clovers], published in Prague in 1913.

In Moravia the disease is known by the vernacular equivalent of 'freezing out', and is popularly considered to be caused by unfavourable winter conditions and especially by frost. Hiltner in Bavaria and Zimmermann in Mecklenburg concluded, on the ground of their experiments in the years 1911, 1912, and 1913, that the disease chiefly attacks clovers of foreign origin, while Ulander in Sweden stated in 1915 that local, wild-growing, white clovers and late-flowering Swedish red clover are resistant to the disease. These views are in contradiction with Kutin's observations in 1913, as he writes that in that year all the indigenous clovers in Bohemia suffered heavily.

The fungus, which mainly attacks young seedlings, has been found on white, red, and purple clovers, both cultivated forms and

escapes, also on lucerne, sainfoin, broad beans, lupins, and some species of weeds.

The principal factors influencing the development of the disease are: (1) a wet autumn, which favours a luxuriant growth of the clover and an abundant production of sclerotia; (2) the time of mowing of the pastures; (3) the density of growth; and (4) the previous cropping and fertilization of the soil.

No methods for controlling the disease are known at present, but the danger of future outbreaks may be minimized by the following measures. Heavily diseased clover fields should be deeply ploughed, as, according to Bubák, at a depth of over 8 cm. under the surface of the soil the sclerotia cannot germinate, while in the superficial layers they retain their viability for about three years. When the clover stands are only thinned out, the soil should be harrowed and dressed with potassium, superphosphates, and sulphate of ammonia. All clover stubble should be cut down or cropped by cattle as early as possible in the autumn, to allow the plants to recover before the cold weather sets in.

SAMPSON (KATHLEEN). **Seasonal notes on the fungus diseases of grasses in the Aberystwyth district.**—*Agric. Progress* (*Journ. Agric. Educ. Assoc.*), i, pp. 106–107, 1924.

During the period 1919–1923, the most important fungous parasites of grasses in the Aberystwyth district, besides the rusts, were *Mastigosporium album* on meadow foxtail [*Alopecurus pratensis*] and *Septoria culmifida* on rough-stalked meadow grass [*Poa trivialis*], timothy [*Phleum pratense*], cocksfoot [*Dactylis glomerata*], and other species.

Severe epidemics of rusts have occurred, resulting in a serious loss of seed. Thus in cocksfoot attacked by *Puccinia glumarum* from May to July, the average weight of seed from 12 panicles was 1·6 gm. with 64 per cent. heavy seed, as compared with 5·3 gm. and 83 per cent. of heavy seed from the same quantity of healthy plants: late attacks caused less damage, the weight per 1,000 seeds not being materially affected. A similar reduction in the yield and quality of seed occurred in timothy attacked by *P. phlei-pratensis*, the weight per 1,000 seeds being reduced from 0·39 to 0·19 gm. in 1922 and from 0·43 to 0·31 gm. in 1923.

A rapid increase in the amount of rust occurred from April to June and a gradual decrease in October to December. The uredo stage has been found on susceptible hosts during the winter months. During the months November to April (1922–1923) the germination percentage of the uredospores of certain grass rusts was low. At the optimum temperature (20° to 22° C.) the lowest average germination was given by *P. glumarum* on cocksfoot and the highest by *P. perplexans* on meadow foxtail. Viable uredospores were obtained during very cold weather (3 to 8 degrees of frost), while in the laboratory some spores germinated at 2° to 5° C.

Aecidial stages of grass rusts are rarely found in the Aberystwyth district, with the exception of aecidia on *Ranunculus ficaria* and *Tussilago farfara* (probably belonging to *Uromyces poae* and *Puccinia poarum* respectively), and the development of epidemics in the spring is believed to be due to the hibernation of the uredo-

spores. It is noticeable that the most severe epidemics occur on the pure species plots at the Aberystwyth Experiment Station.

MOLZ (E.). **Ueber die Giftigkeit des auf Gräsern häufiger schmarotzenden Erstickungsschimmels.** [The toxicity of the 'strangulation' fungus frequently parasitizing grasses.]—*Deutsche landw. Presse*, li, 29, p. 254, 1 fig., 1924.

A brief account is given of the poisoning of geese after feeding on grass infected by *Epichloë typhina*.

The fungus is stated to overwinter by means of the perithecia, and it is recommended that the grass should be mown and burnt before the winter.

KAISER (P.). **Die Stippfleckenkrankheit der Aepfel.** [Bitter pit disease of Apples.]—*Gartenwelt*, xxxvii, 26, pp. 204–205, 1923.

Bitter pit of apples (stated to be often erroneously ascribed in Germany to the attacks of the so-called *Spilocaea pomi*) produces brown spots, 1 to 5 mm. in size and penetrating to a depth of 10 mm., on the fruit, to which an unpleasant bitter flavour is imparted. The spots are more numerous at the calyx end and generally occur only on one side of the fruit.

The disease, which is particularly prevalent on excessively large, juicy, loose-textured fruit, is considered to be due to the unduly rapid evaporation of an inadequate supply of water, resulting in the shrivelling and desiccation of the vascular cells. The cell sap and the acids which it contains become concentrated in the cells from which the water is withdrawn, and eventually destroy the protoplasm, which turns brown as a result of subsequent oxidation with atmospheric oxygen.

The writer has made a study of varietal susceptibility to bitter pit and gives a list of highly susceptible, susceptible, resistant, and immune varieties. In the first category may be mentioned several types of Reinette and Ribston Pippin; in the second Beauty of Boskoop and Cox's Orange; in the third Winter Golden Pearmain and Yellow Bellflower; and in the fourth Gravenstein and Schöner von Nordhausen. The best specimens are stated to be most readily attacked, as are also the first fruits of normally resistant varieties. The apples in the interior of the tree crown appear more susceptible than those at the periphery. Drastic pruning, especially in the summer, and late harvesting favour the disease, which also appears to be promoted by damp, sunless weather, plentiful irrigation, and the abundant application of nitrogenous fertilizers when the fruit is already developed. It was further observed that apples stored in dark, well-ventilated, not too dry cellars showed less bitter pit than those kept in dry rooms.

Control measures, based on the observations recorded above, are briefly indicated.

SALMON (E. S.) & WARE (W. M.). **Occurrence in England of the winter stage (Venturia inaequalis) of the Apple scab fungus.** —*Gard. Chron.*, lxxv, 1945, p. 190, 2 figs., 1924.

Early in February 1924 one of the writers noticed, near Maid-

stone, a number of dead leaves of Bramley's Seedling and Newton Wonder apples which had been severely attacked by scab in the previous summer. The leaves showed traces of dead 'scab' spots on their surface, and on removal to the laboratory produced perithecia which, on maturing, were definitely identified as those of *Venturia inaequalis*, the life-history of which is briefly described. Inoculation experiments with the ascospores are in progress to establish the connexion of this organism with the *Fusicladium* stage. To what extent these winter spores are responsible for spring infections in England is obviously a matter of great economic importance and will require further study in relation to weather conditions.

ROBERTS (J. W.). **Morphological characters of Alternaria mali Roberts.**—*Journ. Agric. Res.*, xxvii, 9, pp. 699–708, 2 pl., 1 fig., 1924.

Alternaria mali was studied under natural conditions in dead spots on apple leaves and on cornmeal agar cultures. A culture of *A. tenuis* from Holland and forms isolated from the leaves of lilac, *Forsythia*, and blackberry, and from the fruits of apple, cranberry, and blueberry were also investigated in culture.

On apple leaves the conidia form minute black masses, readily separable from the leaf. In cornmeal agar cultures chains of conidia form a dark, carpet-like mass on the surface of the medium, while light amber to dark olive or nearly black conidia are also found scattered through the aerial hyphae and in the medium. They are typically arranged in simple or branched chains, verrucose outer walls being common. The conidiophore subtending the first-formed conidium of a chain is produced approximately at right angles to the hypha, and on the separation of the conidium a dark-coloured scar is observed at the point of attachment. The colour of the conidiophores ranges from nearly hyaline to olive.

Measurements were made of conidia from spots on apple leaves. The majority of the conidia (56 per cent.) were 3-septate, the number of septa, however, ranging from one to five. The dimensions of the 3-septate conidia were 20 to 29 by 8 to 13 μ and the average size of all the conidia of varying septation, 28 by 12 μ.

In plate cultures the author observed a case of sectoring which he describes. Mutations are stated also to have been observed in other single conidium cultures of *A. mali* from apple leaves and in those of the *Alternaria* from lilac leaves.

ANDERSON (H. W.). **Some results of spraying Apples at Olney, Illinois, 1923.**—*Trans. Illinois State Hort. Soc.*, lvii (1923), pp. 165–169, 1924.

A 25-year-old Ben Davis apple orchard was selected by the Division of Pomology, Urbana, in 1923 for certain spraying experiments, chiefly directed to control blotch [*Phyllosticta solitaria*] and scab [*Venturia inaequalis*] in addition to insect pests. The following applications were given to the standard plot: (1) dormant, 3 per cent. oil emulsion; (2) lime-sulphur (1–50) and lead arsenate (1–50) at 'pre-bloom', 'calyx', one, two, and three weeks after petal fall; (3) Bordeaux mixture (3–6–50 using hydrated lime) four

weeks, Bordeaux and 2 per cent. oil emulsion with lead arsenate (1–50) six weeks, and Bordeaux 2–4–50 and lead arsenate nine weeks after petal fall; (4) additional sprays of Bordeaux oil emulsion and lead arsenate for the control of bitter rot [*Glomerella cingulata*] and insects.

Almost perfect control of blotch (3·6 per cent. of infection) was secured by this treatment. Where the sprays under (2) were modified by the application of lime-sulphur at petal fall and ten days and three weeks later, the percentage of blotched apples rose to 26·8. The omission of the spray one week after petal fall caused an increase of infection to 15·8 per cent., while the substitution of lime-sulphur for Bordeaux (except at nine weeks after petal fall) resulted in 28·8 per cent. of infection.

Sulfocide and soluble sulphur gave very poor control of blotch, the incidence of which amounted to 14 per cent. in the former case and 44 per cent. in the latter.

The efficacy of hydrated lime was found to be equal to that of rock lime. The addition of Kayso as a spreader did not in general justify its cost.

Previous recommendations for the control of blotch have been based on the assumption that the application of a spray two weeks after petal fall sufficed to prevent infection. During the season under discussion, however, infection must have taken place before this date. Lime-sulphur was found to be less effective than Bordeaux in controlling blotch in the latter part of the season. Dry lime-sulphur was quite as efficacious as the liquid preparation when used early in the season.

NEWTON (F. W.). **The results of spray experiments at Hillview, Illinois, 1923.**—*Trans. Illinois State Hort. Soc.*, lvii (1923), pp. 182–191, 1924.

In a series of spraying experiments on Kinnaird apples for the control of scab [*Venturia inaequalis*] and blotch [*Phyllosticta solitaria*], applications of various fungicides were given in the last week of March (dormant); 'cluster bud' stage, 27th April to 1st May; 'calyx stage', 8th to 10th May; 'ten day' [after petals fall], 23rd to 25th May; 'three weeks', 31st May to 2nd June; 'six weeks', 26th to 28th June; and 'nine weeks', 12th to 13th July.

All the proprietary mixtures tested were fairly efficient. Soluble sulphur and calcium arsenate gave better control than sulfocide or Dow's or Sherwin-Williams's dry lime-sulphur, but caused considerable foliage injury. Previous results indicated the superiority of Bordeaux mixture to lime-sulphur for the early sprays, but this did not hold good for the 1923 season [see also preceding abstract]. The use of hydrated lime in Bordeaux mixture appeared to produce very much more severe russeting of the fruit than was caused by rock lime. The application of a delayed dormant spray of lime-sulphur confirmed the results of the previous year, when the crop was almost totally destroyed. On the whole, it appears that repeated applications of lime-sulphur, especially during periods of high temperature, are injurious, not only to the current, but also to the succeeding crop.

Casein spreaders did not markedly improve control or result in a sufficient saving of spray material to justify their use.

Brooks (C.). **Phoma fruit spot of Apples.**—*Amer. Fruit Grower*, xliv, 2, pp. 14, 28, and 53, 3 figs., 1924.

Phoma fruit spot of apples [*Phoma pomi*] (also known as 'New Hampshire fruit spot', 'fruit speck', and 'Brooks's fruit spot') was reported from Connecticut in 1905, and is now quite generally distributed throughout the United States from Maine to North Carolina, occurring also in Canada. The first record of the disease, however, dates from between 1810 and 1828, when some coloured drawings of infected apples were made at Burlington, New Jersey. The Jonathan, Baldwin, Tolman Sweet, Grimes Golden, Rome Beauty, and Stayman Winesap are the most susceptible varieties, Orange quinces also suffering severely from the disease.

The spots, which seldom exceed $\frac{3}{16}$ of an inch in diameter, are deep red or black on red areas of the fruit and dark green on green or yellow surfaces. The centre of the spot is usually flecked with black. The spots are irregular in outline, slightly depressed, and usually more abundant on the blossom half of the fruit. They sometimes appear by the middle of August, but so faintly as to be frequently overlooked. In fruit which is placed in cold storage immediately after picking the disease seldom undergoes much further development, but if cold storage is delayed or the fruit is held in common storage serious effects may result: the spots may become more sunken and considerably enlarged, developing a distinct corky layer beneath the skin.

Phoma pomi has a long incubation period, and it is somewhat difficult to determine when infection actually occurs. The fruit appears never to be infected before the middle of June or early July, and the period of infection may continue into August. One thorough spraying 8 or 9 weeks after the calyx spray is generally sufficient to ensure control, but in showery weather a repetition 3 or 4 weeks later is advisable. The spray schedule for blotch [*Phyllosticta solitaria*] and bitter rot [*Glomerella cingulata*] is applicable to *Phoma* spot. Bordeaux mixture, lime-sulphur and lead arsenate, or double-strength lead arsenate alone have all given good results in the control of this disease.

Dutton (W. C.). **Cherry diseases and their control.**—*Amer. Fruit Grower*, xliv, 2, pp. 6, 13, and 24, 3 figs., 1924.

A popular account is given of two important fungous diseases of cherries in Michigan, namely, brown rot [*Sclerotinia cinerea*] and leaf spot [*Coccomyces hiemalis*]. The following sprayings are recommended for the control of these diseases. (1) Soon after the petals have dropped. (2) Ten days to a fortnight after (1). (3) Ten days to a fortnight after (2). (4) Just after the fruit is harvested. Bordeaux mixture is stated to cause considerable defoliation and also to impair the quality of the fruit, and lime-sulphur, which gives equally good control, should therefore be preferred.

Colby (A. S.). **Small fruit experiments at the Urbana Station.**—*Trans. Illinois State Hort. Soc.*, lvii (1923), pp. 144–152, 1924.

Notes on the control of various diseases of vines and small fruits are given.

Crown gall [*Bacterium tumefaciens*], rosette, and eastern bluestem of raspberries [see this *Review*, iii, p. 142] are stated to be only controllable at present by thorough roguing of infected individuals and other sanitary measures. Experiments are in progress, however, to test the possibility of controlling the first-named by the application of various chemicals to the soil. Anthracnose of black raspberries [*Gloeosporium venetum*] is readily controllable by two sprays of lime-sulphur, the first during the dormant period and the second a week before the blossoms open. The addition of Kayso has given good results. The Quiller black raspberry is highly resistant to anthracnose, as also are purple raspberries in general. The extended cultivation of the latter is recommended.

Strawberry diseases have been well controlled by a combined spray of Bordeaux (3–4–50) and lead arsenate (2 lb. per 50 galls.) applied before and after blossoming and after the new foliage appears.

Wolf (F. A.). **Strawberry leaf scorch.**—*Journ. Elisha Mitchell Sci. Soc.*, xxxix, 3–4, pp. 141–161, 7 pl., 1924.

The leaf scorch of strawberries is a widely distributed and destructive fungous disease in North Carolina, where it caused an average loss in 1922 of about 20 per cent. of the crop.

Leaf scorch develops on the leaves in the form of minute, purplish or reddish discolorations which rapidly enlarge and gradually extend over the whole leaf; the latter finally assumes a dry, scorched appearance. Affected leaves are commonly curled and have upward rolling margins. Acervuli may be scattered over the spots or they may only appear after the leaf is dry. The lower leaves first become affected, then the new leaves, and the plants either succumb altogether during the summer or partially recover in the early autumn.

On the wild strawberry (*Fragaria virginiana*) the lesions are smaller than on the cultivated varieties and often a single, black, projecting acervulus covers the spot.

On the petioles and peduncles the lesions appear as elongated, sunken, reddish areas or streaks.

The most serious form of the disease, however, occurs on the calyx and is known as the 'dead bur' stage. Irregular brown areas appear, when the plants are in flower, at the tips or margins of the lobes and gradually destroy the entire calyx. Fruit with dry calyces is undersized and of inferior quality. Acervuli are formed abundantly on the lobes.

The acervuli, which vary in diameter from 100 to 200 μ, are formed immediately below the cuticle. The stroma is a thin, hyaline to yellow layer of fungous cells seated directly upon the epidermal cells. The conidiophores arise from the upper side of the stromatic layer as short, perpendicular, cylindrical cells, and produce at their apex successive crops of conidia. These are

extruded through an orifice in the cuticle produced as a result of their pressure. The conidia are hyaline, asymmetrically bicellular, with the upper cell larger and beaked, curved, constricted at the septum, guttulate, and 18 to 30 by 5 to 7 μ.

The results of careful observation showed that infection may take place in 36 to 48 hours. The conidia germinate in 18 to 24 hours and the infection hypha penetrates the cuticle over the lateral walls of the epidermal cells. It then forms a hyaline, intercellular mycelium, with haustoria penetrating the host cells. Within eight or ten days after inoculation the formation of the stromatic layer begins.

In early March decaying leaves infected during the previous season bear on the lower surface of old lesions, minute black dots, the ascigerous stage of the fungus. Mature apothecia are discoid and vary in diameter from 120 to 300 μ. The excipulum is dark brown to black and the hymenial surface yellowish to brown. The abruptly capitate, simple paraphyses extend beyond the asci. These are fasciculate, oblong, tapering bluntly at the thickened apex which becomes the pore, and measure 55 to 70 by 15 to 20 μ. The ascospores are hyaline, elongated, elliptical, curved, unequally bicellular, blunted at the apices, and measure 18 to 28 by 4 to 6 μ.

Pure cultures of several strains of the leaf scorch organism were secured from tissue plantings, conidia, and ascocarps, on a medium of 2 per cent. potato and dextrose agar of varying P_H value. The colonies from all sources were identical in appearance and developed at the same rate, the conidia producing acervuli and the ascospores conidia in three to four weeks. This evidence of the relation between the conidial and ascogenous stages confirms the data obtained by Stone [see this *Review*, ii, p. 15].

Inoculation experiments were successfully performed with suspensions of conidia or ascospores on healthy strawberry plants, but failed on all the 15 species of *Potentilla* tested. The conidial stage of the strawberry leaf scorch organism, therefore, is not believed to be identical with *Marssonina potentillae*. Considerable differences in varietal susceptibility to the disease have been noticed. Of the two commercial varieties grown in North Carolina, the Klondike is highly, and the Missionary moderately, susceptible.

The ascogenous stage of the leaf scorch organism has hitherto been regarded as one of the Pezizeae, but is here shown to be a member of the Phacidieae which, in all essential features, resembles *Diplocarpon rosae* Wolf. *Diplocarpon*, hitherto considered as belonging to the Microthyriaceae, is now placed in the Phacidieae, and the leaf scorch organism named *D. earliana*, English and Latin diagnoses being given.

JONES (L. K.). **Anthracnose of cane fruits and its control on Black Raspberries in Wisconsin.**—*Wisconsin Agric. Exper. Stat. Res. Bull.* 59, 26 pp., 6 pl., 3 figs., 2 graphs, 1924.

Anthracnose (*Plectodiscella veneta*), manifested by purplish to white spotting of the canes, leaves, petioles, peduncles, and pedicels of black raspberries (*Rubus occidentalis*), blackberries (*R.* spp.),

red raspberries (*R. idaeus* var. *aculeatissimus*), and purple-cane raspberries (*R. neglectus*), is stated to be entirely eliminating the raspberry crop in certain sections of the United States, losses being estimated at 12 to 63 per cent. of the crop. Under Wisconsin conditions the black raspberry is the most susceptible host.

The results of the cultural studies described in the present paper showed the minimum temperature for the growth of the fungus on dextrose-potato agar to be about 11° C., the optimum between 20° and 26°, and the maximum about 31°. Conidia [*Gloeosporium venetum*] are not readily produced in culture, but may be obtained in abundance by transferring suitable fragments of cultures from a dry to a very moist atmosphere. The conidia germinate readily in water and on nutrient media, secondary conidia frequently being produced by budding. Ascospores on cultural media usually germinate by the production of five to seven conidia, which in their turn give rise to germ-tubes.

The period of incubation on the canes varies from three to nine days, the disease first appearing when the canes are 8 to 10 in. high. The lesions increase in number on the young shoots during the early summer, resistance being developed with the cessation of growth in July. Ascospores and conidia form the source of natural inoculum during the growing period, the former being forcibly ejected from the asci and carried by the wind for at least half a mile.

Measures for the control of the disease on the lines already indicated [see this *Review*, ii, p. 493] are described.

BRERETON (W. LE G.) & BROADFOOT (H.). **Orchard experiments: trials with controls for Apple mildew.**—*Agric. Gaz. New South Wales*, xxxv, 3, pp. 209–210, 1924.

The continuation of the experiments for the control of apple mildew [*Podosphaera leucotricha*] at Glen Innes Experiment Farm, New South Wales [see this *Review*, i, p. 434], has shown that both atomized sulphur and colloidal sulphur are as effective as atomic sulphur in the control of the disease. Promising results were also obtained with hydrated lime-sulphur, tests with which are being continued.

The cost of the different sprays per 100 galls. is given as follows: atomic sulphur 9*s.* 0*d.*; atomized sulphur 9*s.* 6*d.*; colloidal sulphur 2*s.* 10*d.* hydrated lime-sulphur 4*s.* 3¾*d.*

Empfehlenswerte Mittel für den Obstbau. [Preparations recommended for fruit-growing.].—*Nachrichtenbl. deutsch. Pflanzenschutzdienst*, iv, 3, p. 14, 1924.

The German Plant Protection Service recommends the following fungicidal treatments:

Gooseberry mildew [*Sphaerotheca mors-uvae*] may be controlled by 0·2 per cent. potassium sulphide or 1 per cent. solbar, while de Haën's cosan has also given good results. The first application should be given at double strength during the dormant period and the succeeding ones at fortnightly intervals. A list of varieties particularly susceptible to foliage burning is given.

Apple and pear scab (*Fusicladium*) [*Venturia inaequalis* and *V. pirina*] should be treated with Bordeaux mixture (2 and then 1 per cent.), kurtakol (1 and then 0·5 per cent.), or nosperal (1·5 and then 0·75 per cent.). The first application should be given before the buds open, the second after petal fall, and the third three weeks later.

LYSBAKKEN (S.). **Sommersprøitning i frukthaven.** [Summer spraying in the orchard.]—*Norsk Havetidende*, xl, 10, pp. 111–112, 1924.

Apple scab [*Venturia inaequalis*] is stated to be readily controllable in Norway by the application, just before and shortly after flowering, of lime-sulphur solution with the addition of 0·5 decilitre black leaf tobacco extract and 150 gm. lead arsenate per 50 l. of solution. Lime-sulphur is further recommended for *Monilia* [*Sclerotinia cinerea* (?)] of cherries, various rusts, apple and rose mildews [*Podosphaera leucotricha* and *Sphaerotheca pannosa*], and gooseberry mildew [*S. mors-uvae*].

VILLEDIEU (G.). **A propos de l'action des bouillies anticryptogamiques.** [Concerning the action of anticryptogamic mixtures.]—*Prog. Agric. et Vitic.*, lxxxi, 15, pp. 349–351, 1924.

The author protests against the view attributed to him that sulphate of copper has no fungicidal action against mildew [*Plasmopara viticola*] and emphasizes the salient points of his theory [see this *Review*, ii, p. 374], namely, that the copper contained in the mixtures is not rendered soluble either by rain or dew, that the zoospores are killed only if in actual contact with the insoluble copper oxide, and that the toxicity of the latter is dependent on its basicity. These views are held to explain why mixtures prepared with cadmium sulphate and nickel sulphate have the same fungicidal action as those with copper sulphate. Failures with mixtures prepared with iron or aluminium, or lime [alone], are attributed to the formation of inert oxides and the carbonization of the lime.

Sproeien en sproeiers. [Sprays and sprayers.]—*Versl. en Meded. Plantenziektenkundigen Dienst te Wageningen*, 33, 31 pp., 15 figs., 1924.

In the first section of this paper the principal insect and fungous diseases of the more important horticultural and agricultural crops are briefly described with appropriate control measures.

Section 2 describes the composition and application of Bordeaux mixture, Burgundy mixture (standard and alkaline), Californian mixture [lime-sulphur], solbar, and salicylic acid. Alkaline Burgundy mixture is stated to be very effective in the control of American gooseberry mildew [*Sphaerotheca mors-uvae*], while salicylic acid (10·0 gm. dissolved in 100 c.c. methylated spirit and mixed with 10 l. water containing 200 gm. soap) is recommended against rose mildew [*S. pannosa*]. Bosna Pasta and nosperal [see this *Review*, ii, p. 254] are mentioned as effective substitutes for Bordeaux mixture.

In section 3 the methods of applying the different preparations

are briefly outlined, while section 4 deals with various types of apparatus in general use and with the principles involved in their construction.

SCHMIDT (E. W.). **Ueber die Ausmittelung eines Pflanzenschutzmittels und seine fungizide Bewertung.** [The estimation of a method of plant protection and its fungicidal valuation.]—*Zeitschr. angew. Chemie*, xxxvii, 19, pp. 267–270, 1924.

The author has devised the following system of testing liquid preparations for the control of fungous diseases of plants.

(1) Calculation of physiological values, including (*a*) foliage injury, (*b*) theoretical toxicity, (*c*) practical toxicity, (*d*) opacity.

(2) Calculation of physical values, including (*a*) adhesiveness, (*b*) suspension capacity, (*c*) spraying capacity, (*d*) visibility.

(3) Practical values arising out of the foregoing, especially the sum-total of the practical toxicity and adhesiveness.

The tendency to produce foliage injury may be well tested on sensitive plants such as bean, gooseberry, or apple.

The theoretical toxicity includes both the spore-destroying and germination-inhibiting properties of the toxic agent. These qualities may be tested on spores of *Botrytis cinerea* (10,000 per c.c.) derived from 10-day cultures on prune agar at a temperature of 18° to 20° C. The spore-destroying value is estimated by the length of time required for the killing of the spores at the optimum temperature of 24° in a solution of 1 per cent. in twice distilled water. The figure 100 represents complete spore destruction in 1 hour, 1,000 in 0·1 hour, and 1 in 100 hours. The germination-inhibiting properties are determined by the quantity of the toxic agent required permanently to check germination (absolute prevention) on a medium composed of 0·01 gm. KH_2PO_4, 0·01 $CaCl_2$, 0·03 $MgSO_4.7H_2O$, 0·01 gm. NaCl, 0·001 gm. $FeCl_6$, 1 gm. asparagin, 1 gm. dextrose, and 100 c.c. H_2O. The index figure is calculated as 1/ the percentage strength of the solution required. Relative prevention is tested by ascertaining at what concentration the preparation retards germination and arrests development. For relative prevention 1 represents a delay in spore germination of 10 days compared with the untreated controls, 0·9 corresponds to 9 days, 0·1 to 1 day, and so forth.

Practical toxicity is tested by spraying the preparation on to a spore suspension of *B. cinerea* on a collodion membrane. If no germination takes place within 10 days, the figure for practical toxicity is 1, other values being calculated as above.

Opacity may be tested by spraying the preparation on glass plates, which are then placed in a photographic printing-frame with celloidin paper and developed. A similar test may be carried out with leaves extracted with alcohol. The amount of opacity produced by a 2 per cent. Bordeaux mixture may be regarded as the utmost admissible limit. In relatively sunless years even this degree of opacity may cause considerable damage.

The most important physical property of a preparation is adhesiveness. To test this, photographic glass plates are weighed, sprayed with the fungicide, dried at room temperature for 48 hours, and re-weighed. The plates are then subjected to artificial rain

(*Zeitschr. für Pflanzenkrankh.*, xvii, 1, 1907) for an hour, dried, and weighed. The difference between the weighings indicates the quantity washed off by the 'rain'. If nothing is washed off the adhesive value of the preparation is 1, other values being calculated as fractions of 1 down to 0 when all is removed. The adhesiveness of a new preparation should be at least equal to that of a 1 to 2 per cent. Bordeaux (0·5).

Suspension capacity is determined by placing 150 c.c. of the well-stirred preparation in a test-tube and ascertaining the length of time required for sedimentation. The figure 1 is reached when no perceptible sedimentation occurs in an hour, e. g., by the colloidal mixtures ciprin, cosan (de Häen), and kurtakol. The two first-named have a suspension capacity of 10 and above, while Bordeaux mixture and nosperal form an abundant deposit in 30 minutes (0·5), and Urania green plus lime does the same in 10 minutes (0·16).

The spraying capacity of a preparation must be such that it will pass through the fine holes of a modern apparatus without clogging. Colloidal preparations form spots with a thick, wide, peripheral margin, while Bordeaux mixture forms a circular conglomeration of lime in which the copper hydroxide is precipitated for the most part near the centre. The significance of this difference of distribution lies in the fact that the nearer the toxic agent approaches to the edge of the spot (as in the colloidal preparations), the better is the protection afforded to those parts of the leaf not actually covered by the spray.

Visibility must be studied on the leaves of the plants for which the preparation is intended. Though of some practical interest, this quality should never be allowed to set the standard for the value of a fungicide.

The sum-total of the physiological and physical values indicates the presumable practical efficacy of a preparation. For Bordeaux mixture this figure, calculated on the basis of practical toxicity (0·2) and adhesiveness (0·5), is 0·7, i. e., somewhat below medium value, since the highest theoretical value is 2. Owing to its relatively high adhesive value, however, the preparation is of practical utility. Adhesiveness, therefore, is of the first importance. Brilliant green, which has recently been shown [see this *Review*, iii, p. 409] to possess an immensely strong fungicidal action, is in practice useless as a fungicide owing to its entire lack of adhesiveness. Generally speaking, the adhesive value should not fall much below 0·5, while the practical toxicity should exceed 0·2.

KOTTE (W.). **Zur Beurteilung von Pflanzenschutzmitteln im Laboratoriumsversuch.** [The valuation of methods of plant protection in laboratory experiments.]—*Zeitschr. angew. Chemie*, xxxvii, 29, pp. 508–509, 1924.

Schmidt's valuable work on the testing of fungicides in the laboratory [see preceding abstract] is stated to require supplementation in one respect, namely, that the toxicity of a particular preparation should be tested against the fungus which it is destined to combat in the field.

Schmidt tested the fungicidal value of Bordeaux mixture against

Botrytis cinerea, and naturally found it slight, since it is admittedly unsuitable for the control of that particular organism. Hence he concludes that the efficacy of the preparation rests mainly on its high adhesive properties. That this deduction is erroneous is shown, however, by the present writer's laboratory tests of the action of Bordeaux mixture on vine mildew [*Plasmopara viticola*], in which 0·00008 per cent. of the mixture destroyed 35,000 spores per c.c. The fungicidal value of Bordeaux mixture in the control of the disease for which it is primarily employed is, therefore, exceedingly high.

SCHMIDT (E. W.). **Wie kommt die Wirkung der Kupferkalkbrühe zustande?** [How is the effect of Bordeaux mixture accomplished?]—*Centralbl. für Bakt.*, Ab. 2, lxi, 11–18, pp. 356–367, 1924.

The results of laboratory experiments on the action of copper hydroxide and Bordeaux mixture on the spores of *Botrytis, Fusicladium,* and *Monilia* showed that the former failed to arrest germination within the time limit of the test (200 hours), while the latter succeeded.

The toxicity of Bordeaux mixture cannot be ascribed to the exosmosis by the spores of substances promoting the solution of copper hydroxide, since this phenomenon was not observed. The superior toxicity of Bordeaux mixture over identical amounts of copper hydroxide was found to be due to its alkalinity, and to decline on exposure to the air. The characteristic action of freshly made Bordeaux mixture may be said, therefore, to be due to the combined influence of the copper brought into solution by the carbonic acid present in the atmosphere and the repressive action of the alkali contained in the preparation.

In general, Bordeaux mixture is unable to cause the immediate death of fungous spores provided with a membrane, long contact being necessary to ensure the permanent cessation of germination. The well-known prophylactic properties of Bordeaux mixture would appear to be due to a modification, detrimental to the fungus, of the normal physiological conditions promoting germination, in consequence of the above-mentioned combined action of copper and alkali. The consequent arrest of germination may be absolute or relative; in the latter case the spores are too feeble to produce hyphae, so that the practical object of the treatment is even here attained. The germ-tubes, unable to penetrate the leaves, soon perish of inanition. This process explains the practical efficacy of Bordeaux mixture in nature notwithstanding its comparatively low toxicity *in vitro.*

FRIEDRICHS (G.) & KOTTHOFF (P.). **Die biologische Kontrolle der Saatbeizmittel.** [The biological control of seed disinfectants.] —*Deutsche landw. Presse*, li, 17, p. 184, 1924.

The results of experiments conducted in 1921 and 1922 at Münster (Westphalia) on different varieties of wheat seed-grain, with a number of the better known commercial seed steeps, are described.

In 1921 only formaldehyde (0·1 per cent. sprinkling or immersion

for 15 minutes) and copper sulphate (1 per cent. sprinkling or immersion for 1 hour) reduced the germinative capacity of the seed. In 1922, however, all the preparations used resulted in a considerable reduction of germination, which was least (10 per cent.) with uspulun and fungolit (0·25 per cent., 1 hour's immersion) and highest with copper sulphate. Weizenfusariol appears better adapted for sprinkling than for immersion, causing a considerable reduction in germination by the latter method. The remaining preparations (especially formaldehyde, kalimat, segetan II, and tillantin C) caused reductions varying from 20 to 25 per cent. Tillantin C also produced malformations of the cotyledon and roots of the seedlings.

Germisan, fungolit (or 'Hohenheimer Beize', as it is now called), uspulun, and tillantin B cause relatively little injury to the seed, the quantity of which should, however, be increased when treatment with formaldehyde or kalimat is contemplated. The use of copper sulphate and segetan II should be discontinued.

Westermeier (K.). **Die Wirkung verschiedener Beizmittel gegen nachträgliche Steinbrandansteckung.** [The effect of various disinfectants against reinfection by bunt.]—*Deutsche landw. Presse*, li, 13, p. 136, 1924.

Experiments were carried out in Thüringen with Rimpau's Red Schlanstedter wheat to ascertain how far formaldehyde, germisan, and uspulun protect seed treated with them against reinfection by bunt [*Tilletia tritici* and *T. levis*]. A portion of the disinfected seed was heavily dusted with bunt spores, in some cases immediately after treatment and in others not until eleven weeks later.

Germisan was found to afford very good protection against reinfection, especially when treatment, dusting with spores, and sowing were carried out in rapid succession. Uspulun was much less effective than germisan, but considerably superior to formaldehyde. With the latter the incidence of infection was found to be heavier when the dusting of the seed with bunt spores was carried out shortly after treatment, and the seed left for a considerable period before sowing, than when the dusting took place shortly before sowing.

Womit soll man beizen? [Which are the best disinfectants?]—*Nachrichtenbl. deutsch. Pflanzenschutzdienst,* iv, 3, pp. 13–14, 1924.

The following treatments are recommended as the result of repeated successes in experiments carried out by the German Plant Protection Service.

(1) For bunt of wheat [*Tilletia tritici* and *T. levis*]. Formaldehyde 0·1 per cent. (i.e., $\frac{1}{4}$ l. of commercial 40 per cent. solution per 100 l. of water), immersion for 15 minutes. Sowing should not be delayed more than two days after treatment. Germisan 0·25 per cent., immersion for half an hour. Hohenheimer Beize ['fungolit'] 0·25 per cent., immersion for one hour. The seed should remain covered with sacks for three hours after treatment. Kalimat 0·25 per cent., immersion for half an hour: some injury to

germination occasionally results. Uspulun 0·5 per cent., immersion for half an hour: the prescribed 0·25 per cent. solution is not always sufficiently powerful for the control of bunt. Weizenfusariol according to directions, immersion for 15 minutes: germination may occasionally be impaired.

Of the preparations tested for the first time in 1923, good results were given by segetan, 1 per cent., immersion for one hour; sublimoform according to directions, 15 minutes' immersion; and tillantin B, 0·4 per cent., 1 hour's immersion. The 0·2 per cent. solution of the latter is not uniformly efficacious in bunt control.

(2) Stripe disease of barley [*Helminthosporium gramineum*]. Germisan or uspulun 0·25 per cent., immersion for one hour.

(3) Loose smut of oats [*Ustilago avenae*]. Formaldehyde, germisan, Hohenheimer Beize, kalimat, or sublimoform, as recommended for the control of bunt. Sprinkling with formaldehyde (7 to 8 l. per zentner of oats) also gives good results.

(4) Loose smuts of wheat and barley [*Ustilago tritici* and *U. nuda*]. Hot-water treatment is the only effectual one. The seed should be soaked for four hours in loose sacks at 30° C., followed by immersion for ten minutes at 50° to 52° C., and rinsing in cold water or spreading out to dry.

ANDERSON (J. P.). **Botrytis cinerea in Alaska.**—*Phytopath.*, xiv, 3, pp. 152–155, 1 pl., 1924.

The result of nine years' observations in south-east Alaska have convinced the writer that *Botrytis cinerea* is by far the most serious fungous parasite in that region, causing more than three-quarters of all the fungous injury to cultivated plants. The cool, damp climate appears particularly conducive to the development of the fungus.

No species of flowering plant appears to be immune from *B. cinerea*, and even pteridophytes and bryophytes become infected by contact with diseased portions of phanerogams. Considerable differences in host susceptibility, however, have been observed. Blueberry fruit (*Vaccinium*), for instance, is much less frequently infected than the salmonberry (*Rubus spectabilis*), whilst the cultivated strawberry is extensively attacked. *Botrytis* tends to disappear as the fruit dries, and is replaced by other fungi, especially *Cladosporium herbarum*.

The fungus, which has not been encountered in its supposed ascigerous stage, *Sclerotinia fuckeliana*, has been collected on over 100 hosts [a list of which is given], and from cross-inoculation experiments it appears that the species concerned is the same in all cases.

MORSTATT (H.). **Bibliographie der Pflanzenschutzliteratur: das Jahr 1923.** [Bibliography of plant protection literature published in 1923.]—*Biol. Reichsanst. für Land- und Forstwirtsch.*, Berlin-Dahlem, 160 pp., 1924.

This valuable compilation, presenting a comprehensive survey of the literature published during 1923 on diverse aspects of plant protection, has been prepared on similar lines to those adopted in previous years [see this *Review*, ii, p. 417].

DE MELLO (F.) & PAES (S.). **Sur un Trichophyton à culture faviforme, agent d'une teigne du cuir chevelu.** [A *Trichophyton* with faviform cultures, the causal organism of a ringworm of the scalp.]—*Cong. de Méd. Trop. de L'Afrique occidentale, Loanda*, 10 pp., 2 pl., 1923. [Abs. in *Bull. Inst. Pasteur*, xxii, 10, p. 410, 1924.]

In the hair of a native Congolese child suffering from inflamed, nodular, and suppurating wounds of the scalp was found a parasitic fungus of the large-spored, endo-ectothrix type. The cultures were faviform, chocolate-coloured on malt agar, paler on glucose. The figures indicate that conidia, simple or ramified conidiophores, pectinate bodies, and chlamydospores, were present in the cultures. The fungus has been named *Favotrichophyton angolense*.

HORTA (P.). **Uma nova tinha microsporica brazileira, 'Microsporon Ramos' n. sp. (Nota previa).** [A new small-spored Brazilian ringworm, *Microsporon ramos* n. sp. (Preliminary note.)]—*Brazil Medico*, xxxviii, p. 59, 1924. [Abs. in *Bull. Inst. Pasteur*, xxii, 10, p. 410, 1924.]

In two cases of ringworm of the scalp in Brazil a fungus has been isolated which rapidly forms, on agar cultures with saccharose, a deep yellow and a red pigment and subsequently a floccose white covering. This *Microsporon* differs from *M. ferrugineum* in the colour and appearance of the cultures, which resemble those of *M. equinum*, and in the presence of numerous external spores. It is distinguished from the other coloured species of *Microsporon* by the absence of pluriseptate conidiophores and is named *M. ramos*.

BLANC (G.) & CAILLOU (L.). **Sur une mycose aspergillaire observée en Tunisie.** [An aspergillary mycosis observed in Tunis.]—*Bull. Soc. Path. Exot.*, xvii, 5, pp. 343–345, 1 fig., 1924.

From an ulcerated tumour on the hand of a native of Tunis the authors obtained, on various media, cultures of a fungus with greenish colonies resembling those of an *Aspergillus*. The cultures were submitted to Dr. Langeron for diagnosis [see next abstract].

LANGERON (M.). **Un Sterigmatocystis nouveau, parasite de l'homme en Tunisie. S. tunetana n. sp.** [A new *Sterigmatocystis* parasitic on Man in Tunis. *S. tunetana* n. sp.]—*Bull. Soc. Path. Exot.*, xvii, 5, pp. 345–347, 1 fig., 1924.

The fungus isolated from the hand of a native of Tunis [see preceding abstract] has been provisionally identified as a new species of *Sterigmatocystis*, for which the name *S. tunetana* is proposed, a diagnosis being given.

The author further proposes the establishment of a new section of *Sterigmatocystis* in addition to the five already recognized (Syll. fung. iv, 1886; x, 1892; xxii, 1913) to bear the name *versicolores* and include *S. bicolor*, *S. elegans*, *S. polychroma*, *S. versicolor*, *S. violaceofusca*, and *S. tunetana*.

Kunkel (L. O.). **Further studies on the intracellular bodies associated with certain mosaic diseases.**—*Bull. Exper. Stat. Hawaiian Sugar Planters' Assoc.*, Bot. Ser., iii, 2, pp. 108–114, 2 figs., 1924.

The discovery of amoeboid bodies in the cells of mosaic plants of maize, *Hippeastrum equestre*, Chinese cabbage (*Brassica pekinensis*), sugar-cane, and tobacco has already been reported [see this *Review*, i, pp. 194, 195, and ii, pp. 241, 513].

The bodies of *Hippeastrum* mosaic show a very definite structure, usually finely reticulate like that of protoplasm. They seem to be in direct contact with the protoplasm of the host cell and have never been seen to occupy a vacuole. One or more deeply staining granules (apparently not nuclei) have occasionally been observed. In Chinese cabbage the bodies are about the same size as those of *Hippeastrum*, and are frequently surrounded by chloroplasts. The bodies associated with sugar-cane mosaic are more irregular in shape than those of any of the other plants studied, and stain more deeply. In mosaic tobacco plants they are similar to those of maize and *Hippeastrum*.

The amoeboid bodies associated with mosaic diseases are thought possibly to represent only one stage in the life of the causal organism. At another stage they may be sufficiently small and plastic to pass through the fine pores of a filter and escape detection under the microscope. They probably become visible only after a certain period of growth within the host cell. Much further research is necessary, however, before any definite conclusions can be reached beyond stating that intracellular amoeboid bodies, resembling living organisms, accompany mosaic disease in several plants and, in maize and *Hippeastrum*, are associated with chlorotic conditions producing a mosaic pattern in the leaves.

Robertson-Proschowsky (A.). **Un champignon destructeur de Palmiers sur la Côte d'Azur.** [A fungus destructive to Palms on the Riviera.]—*Rev. de Bot. Appliquée*, iv, 30, pp. 106–108, 1924.

In 1915 the writer observed on the palm *Archontophoenix cunninghamiana* at Nice a fungus which has since caused the death of various individuals of the same species and also of *Howea forsteriana*, *Washingtonia filifera*, and *W. robusta*.

The first symptom of the disease was the death of the youngest leaves, followed by the swelling, in oval to oblong patches several centimetres in length and up to half a centimetre in breadth, of portions of the epidermis of the upper part of the trunk. Longitudinal fissures gradually appeared in the affected areas, disclosing dense aggregations of brick-red spores. Some months later similar fissures were observed at the base of the trunk, resulting in the death of the tree.

The fungus was identified by Dr. Westerdijk as *Penicillium roseum*, hitherto known only as a saprophyte, and by Patouillard as belonging to the group of *P. roseum* var. *coremioides*, with a strong resemblance to *P. incarnatum*. A similar disease is stated to occur on hothouse palms in the Natural History Museum in

Paris. It is thought to be a kind of bud rot caused by a *Penicillium*.

ROBBINS (W. J.). **Isoelectric points for the mycelium of fungi.**—*Journ. Gen. Physiol.*, vi, 3, pp. 259–271, 2 diag., 1924.

A full account is given of a series of experiments conducted at Missouri University, Columbia, United States, to ascertain the reaction to various acid and basic dyes of the mycelia of *Rhizopus nigricans* and *Fusarium lycopersici*.

When grown on potato dextrose agar, the reaction of which was varied with phosphoric acid, the extent of colony growth of *Rhizopus nigricans* plotted against the initial Sörensen value of the agar produced a double maximum curve with the minimum between the two maxima at initial P_H 5·2. When grown in potato broth under similar conditions the dry matter produced by *R. nigricans* plotted against the Sörensen value gave a double maximum curve with the minimum between the two maxima at initial P_H 5·2 or average P_H 4·9.

When stained with water-soluble eosin, methylene blue, basic fuchsin, and safranin, and washed with buffer mixtures of 0·1 M phosphoric acid and sodium hydroxide, the mycelium of *R. nigricans* responded much like an amphoteric colloid with an isoelectric point near P_H 5·0.

Mycelium of *R. nigricans* placed in buffer mixtures of 0·01 M phosphoric acid and sodium hydroxide of P_H 4·1 to 6·3, changed the reaction in most cases towards greater alkalinity.

The results of similar experiments with *Fusarium lycopersici* grown for the author by Scott [see below, p. 613] in culture solutions of varying acidities, showed that when the dry weights of the mycelia were plotted they produced a curve with a minimum between two maxima at an average of P_H 5·5. In dye absorption the mycelium responded like an amphoteric colloid with an isoelectric point near P_H 5·5.

Eosin was the only satisfactory acid dye. Orange G and Martius yellow were washed out of the mycelium too readily, while acid fuchsin acted as an indicator and became colourless in the alkaline solutions.

MÜLLER (H. C.), MOLZ (E.), & MÜLLER (K.). **Ueber den Einfluss der Ueberwinterungsart der Saatknollen auf Gesundheit und Ertrag der Kartoffeln.** [The influence of the methods of winter storage of seed tubers on the health and yield of potatoes.]—*Deutsche landw. Presse*, li, 11, pp. 113–114, 1924.

The results of experiments in the effect on the yield of different methods of winter storage of seed potatoes carried out at the Halle Phytopathological Experiment Station in 1919–20, and again in 1922–23, are described. In the first case a comparison was made between storage (1) in the open as ordinarily practised; (2) in the soil at a depth of 25 cm.; (3) in a shed at 10° to 16° C.; (4) in a sack in the same shed; (5) in a sack in a heated laboratory (15° to 18°); (6) the same, 4 days in the open at 2° to 4°; (7) in a fairly warm room (8° to 12°) in an upright, spherical, glass flask opening at the top; (8) the same as (7) but with the flask opening at the

bottom; (9) the same as (7) in a sack; (10) the same as (7) in a zinc vessel opening at the bottom; (11) the same as (7) in a horizontal copper vessel; and (12) the same as (7) in a clay vessel opening at the bottom. The varieties used in the tests were Königsniere (in all), Wohltmann (in 1 to 6), and Rheingold (in 7 to 12).

It was found that both (1) and (2) gave good results as regards yield, 62·15 and 64·75 kg. respectively being the average from 100 tubers each of Königsniere and Wohltmann. Storage in warm rooms (except where accompanied by a few days in the open) led to a reduction in yield, degeneration, and an increase in leaf roll in Wohltmann. The accumulation of respiratory carbonic acid gas where this was unable to escape freely from the storage-space greatly reduced the yield (to 51·52 kg. from 100 tubers each of Königsniere and Rheingold). The potatoes stored in a copper vessel gave a higher yield than those in zinc or clay containers.

In the second experiment two lots of Industrie and the so-called 'red yellow-fleshed biscuit' were stored (*a*) in the open and (*b*) in the laboratory at 10° to 16° C. in a sand-lined box. The potatoes were planted on 19th April and 1st and 17th May, and the best yields in all cases were obtained from the potatoes stored in the open. The average yield of the 19th April plantings was 51·15 kg. from 100 tubers of each variety stored in the open, against 45·07 kg. from those stored in the laboratory; the corresponding figures for 1st May were 49·32 as against 38·68 kg., and those for 17th May 36·34 compared with 32·32 kg. It is apparent from these figures that early planting, as well as storage in the open, exercises a favourable effect on the yield. When storing potatoes in the open on heavy clay soils aeration should be secured by means of a straw covering.

SCHLUMBERGER (O.). **Die Produktion von krebsfesten Pflanzkartoffeln im Jahre 1923.** [The production of wart-immune seed Potatoes in 1923.]—*Deutsche landw. Presse,* li, 11, pp. 112–113, 1924.

The production of seed potatoes immune from wart disease [*Synchytrium endobioticum*] in Germany is stated to have risen from 1,269,760 zentner in 1922 to 2,040,024 in 1923. From statistics of the production of the recognized immune varieties [a list of which is given] it is apparent that the increase of 1923 over the previous year was largely due to the extended cultivation of Richter's Jubel, Modrow's Preussen, and von Kameke's Pepo, Arnika, and Beseler.

The wart disease situation in Germany, where the infected area is stated to cover 25,000 hect., representing 8,000,000 zentner of potatoes, is briefly outlined and the necessity for further intensive production of wart-immune varieties emphasized.

SPIECKERMANN (A.) & KOTTHOFF (P.). **Die Prüfung von Kartoffeln auf Krebsfestigkeit.** [The testing of Potatoes for immunity from wart disease.]—*Deutsche landw. Presse,* li, 11, pp. 114–115, 1924.

Owing to the difficulty of conducting the usual field tests for

immunity from potato wart disease [*Synchytrium endobioticum*] in the occupied areas of Germany, the authors have devised a means of carrying out the work in the laboratory. Slices of potatoes with eyes, 2 to 3 cm. across and 1 cm. thick, are placed with the eyes uppermost, on a layer of damp sand, 2 cm. in depth, in boxes, and a layer of damp, wart-infested compost spread over them. The boxes are placed open in the room or in a saturated atmosphere at 16° to 20° and kept damp. At the end of three weeks the sand and compost are removed, and it will be found that susceptible varieties show the characteristic excrescences.

Of the 33 varieties tested, all except Kuckuck, Magdeburger Blaue, Beseler, Parnassia, Nepeta, Preussen, and Johannsen (recognized as wart-immune by the German Plant Protection Service, Parnassia and Johannsen being subject to confirmation), were more or less heavily infected.

Very slight infection occurred on the Kuckuck, Magdeburger Blaue, Nepeta, and Preussen under laboratory conditions, but this is regarded as of no practical importance in view of their proved resistance in the field and the optimum conditions for infection constantly maintained in the laboratory tests.

STRANAK (F.). **Rozšíření rakoviny bramborů v Československe republice.** [The spread of wart disease of Potato in the Czecho-Slovak Republic.]—*Ochrana Rostlin*, iv, 1, pp. 1–2, 1 map, 1924.

The occurrence in 1923 of cases of wart disease (*Chrysophlyctis endobiotica*) [*Synchytrium endobioticum*] of potato in a number of localities in Czecho-Slovakia at a great distance from Sluknov, the original focus of infection, and the discovery of a fresh focus at Hlučin, is causing anxiety to the authorities concerned. An appeal is therefore made to potato growers to exercise the utmost vigilance and to report any suspicious symptoms to one of the Plant Protection Stations, a list of which is given. A list is also given of German and English wart-resistant varieties of potatoes, the planting of which is strongly recommended.

MURPHY (P. A.) & MCKAY (R.). **Investigations on the leaf-roll and mosaic diseases of the Potato.**—*Journ. Dept. Agric. & Tech. Inst. Ireland*, xxiii, 4, pp. 344–364, 5 pl., 1 diag., 1924.

The investigation of leaf roll and mosaic diseases of the potato [see this *Review*, iii, p. 160] was continued at Glasnevin, near Dublin, during 1923.

In spite of the fine, dry, late spring and early summer comparatively few insects developed, the common green aphids (*Macrosiphum solanifolii*) being particularly scarce. The spread of the diseases, though less extensive than in 1921, was still so considerable that the health of uncaged plants could not be guaranteed.

Evidence was obtained that the so-called 'degeneration' of the potato is not necessarily associated with old varieties, since some of the latter grown on the west coast of Ireland and examined at Glasnevin were found to be remarkably vigorous and comparatively healthy. With the exception of Irish White, however, the vitality

and productivity of the old varieties was reduced to a greater extent by brief exposure to mosaic and leaf roll than by prolonged propagation on the west coast.

The characteristics of both mosaic and leaf roll are frequently obscured by a combination of the two diseases and it is almost certain that the extremely severe losses sometimes attributed to leaf roll are partially due to subsequent infection by mosaic or some other virus disease. The authors distinguish three types of mosaic, namely, simple mosaic, crinkle, and streak or stipple-streak [see this *Review*, ii, p. 285], brief descriptions of each form being given.

Up to the present no varieties have been found immune from leaf roll or mosaic. Barley Bounty, an ostensibly immune variety, was shown by transmission experiments on susceptible varieties to be a carrier of these diseases, although the symptoms may not be manifested or only in a very masked form.

In a test carried out with Invincible, President, and Leinster Wonder plants grown from true seed, one seedling of the first-named variety showed unmistakable symptoms of leaf roll under conditions which leave no alternative but to conclude that occasionally leaf roll is conveyed directly from the parent plant to the embryo in the seed.

A study of the effect of the place of origin of potatoes on their value for seed purposes, the data of which are presented in tabular form, yielded no very conclusive results. Good and bad seed-tubers were found in the same counties, both in the north and south, and even on the same farm. The presence of a high percentage of disease in the crop supplying the 'seed' proved, however, to be definitely correlated with heavy leaf roll and mosaic infection in the progeny.

An attempt was made to detect the presence of virus diseases by means of external symptoms on the tubers. Certain extreme cases of leaf roll were characterized by a dirty yellow colour of the flesh; a granular and water-soaked appearance of the cut surface; the development of a brownish-red colour after cutting; and necrotic areas round the vascular ring. These features, however, were not sufficiently constant to afford a reliable criterion for the separation of diseased and healthy tubers.

Experiments in the control of leaf roll and mosaic by roguing were moderately successful when the operation was carried out on five different dates, between 9th June and 4th September, the natural annual increase of infection being neutralized and the percentage reduced to about the amount present in 1922. A single roguing on 9th August also gave a fair degree of success, but two early roguings in June and July were a complete failure and the results indicate that no great progress is to be anticipated in this direction.

The available data on the effect of virus diseases on immunity from wart disease [*Synchytrium endobioticum*] show that neither the fifteen standard immune varieties nor the old immune varieties forfeit any degree of their natural resistance through exposure to leaf roll and mosaic. Immunity from wart disease appears to be a stable character which is retained independently of age and the

complex of disturbances inseparable from the vegetative propagation of the potato. [See also this *Review*, iii, p. 172.]

Departmental Activities: Botany: Internal brown fleck of Potatoes.—*Journ. Dept. Agric. S. Africa*, viii, 3, p. 266, 1924.

Internal brown fleck of potatoes causes serious losses during some seasons in South Africa, the severity of the disease depending on climatic factors which are imperfectly understood. Experiments are described in which the addition of lime at the rates of 2,000 lb., 1,000 lb., and 800 lb. per acre to soil, which had previously produced a badly flecked crop, resulted in only 7, 23, and 25 per cent. flecked tubers, although infected seed was used. A control plot gave 39 per cent. infected, whilst the application of an acid fertilizer (500 lb. superphosphate, 200 lb. potassium sulphate, and 300 lb. ammonium sulphate per acre) unexpectedly reduced the amount of fleck to 20 per cent.—a discrepancy for which no explanation is offered. A further test with lime corroborated the earlier results, which have also been substantiated by the experience of farmers.

SCHLUMBERGER (O.). **Tagesfragen zur Kartoffelbeizung.** [Questions of the day in connexion with Potato disinfection.]—*Mitt. deutsch. Landw.-Gesellsch.*, xxxix, 13, pp. 236–237, and 14, pp. 257–259, 1924.

After a general discussion on some of the problems connected with potato disinfection, the author describes an extensive series of experiments carried out in a number of different localities under the auspices of the [Dahlem] Biological Institute.

The tests were conducted on different commercial varieties with uspulun and germisan (0·25 and 0·05 per cent., immersion for 15 minutes to 1 hour), uspulun- and germisan-bolus (0·5 kg. per 1 'doppelzentner' seed), corrosive sublimate, sublimoform, tillantin B, and a few preparations not yet on the market. The action of the latter, however, was devastating, resulting in losses of 20 to 90 per cent.

Early potatoes, e.g., Kuckuck, were more sensitive to the effects of the fungicides than the medium and late varieties, such as Deodara and Wohltmann. The best results as regards yield were obtained by treatment with germisan- and uspulun-bolus, in spite of the fact that these preparations were responsible for most gaps in the stand.

The results of the local tests were less uniform than those carried out at the Biological Institute, but on the whole the use of the fungicides appears to have resulted in a distinct reduction of yield, especially in the case of uspulun 0·5 per cent., 1 hour's immersion, and germisan 0·5 per cent. immersion for half an hour and one hour.

It is pointed out that, in the present state of German finances, seed treatment of potatoes can only be justified by increased yields of at least 5 cwt. per acre. In view of the above results, the general adoption of this costly process cannot at present be recommended.

Holmes (F. O.). **Herpetomonad flagellates in the latex of Milkweed in Maryland.**—*Phytopath.*, xiv, 3, pp. 146–149, 10 figs., 1924.

A flagellate infection of milkweed (probably *Asclepias syriaca*) was discovered during the autumn of 1923 near Baltimore, Maryland. The organisms are stated to correspond fairly closely to *Herpetomonas elmassiani* Migone (*Bull. Soc. Path. Exot.*, ix, p. 356, 1916). This is believed to be the first record of such organisms in the United States. A red and black hemipterous insect, *Oncopeltus fasciatus*, is suspected as an agent of transmission owing to its almost constant association with the infected plants and to the detection of the flagellates in the intestinal tract of both adults and nymphs. The infected plants were distinctly yellower than the uninfected seedlings, a phenomenon which may have been due to flagellosis, since the latex was converted from a smooth, creamy fluid to a watery emulsion of organisms.

Falck (B.). **Erweiterte Denkschrift über die Bedeutung der Fadenpilze für die Nutzbarmachung der Abfallstoffe zur Baumernährung im Walde und über die Möglichkeit einer nachträglichen pilzlichen Aufschliessung des Trockentorfs.** [Extended memoir on the importance of the Hyphomycetes in rendering organic detritus available for the nutrition of forest trees and on the possibility of a subsequent decomposition of the dry peat by fungi.]—*Mykol. Untersuch. und Ber.*, ii, pp. 38–72, 1923. [Received 1924.]

The deficiency of nutrient substances and the consequent deterioration of forest soils resulting from an abnormal accumulation of raw humus is stated to be mainly due to the absence of the usual hyphomycetous vegetation.

In normal forest soils the Hyphomycetes (assisted at a later stage by Mucoraceae, &c.) are sometimes responsible for the complete decomposition of fragments of timber, decaying leaves, conifer needles, and the like. Certain Basidiomycetes may also be associated in this work of complete decomposition, a process which the author terms 'mycocriny'. An account of the chemical changes involved in this process is given.

Frequently, however, the work of decomposition by the Hyphomycetes is interrupted by the depredations of insects (larvae of flies and beetles) which devour the entire mycelium together with the detritus of leaves, &c., on which it is growing, and convert the material by their digestive processes into a dark, crumbling humus mass ('anthracriny'). This type of decomposition is probably initiated by humus-forming bacteria in the alimentary canal of the insects.

Humus-containing soils formed as above are stated to consist of the following strata:—(1) The uppermost, unchanged layer of detritus; (2) the fungus-infested layer, most conspicuous in the spring and early summer; (3) the actual humus layer, the lower portion composed of dark-coloured insect excreta and the upper part mixed with partially or totally decomposed foliage and the like; (4) the uppermost layer of the mineral soil, which contains the extractives of the humus layer leached out by rain-

water, and is consequently traversed by the densest network of tree roots.

In the absence of adequate fungous vegetation the undecomposed foliage, &c., collects on the surface of the soil and becomes humified by chemical changes which are quite different from those occurring in anthracriny. The chemistry of this process (designated as 'anthrageny') is stated to be obscure. The raw humus masses are converted into dry peat, and their carbon, nitrogen, phosphorus, and potassium are rendered permanently inaccessible to the trees.

Discussing the factors promoting mycocriny and anthracriny, the author enumerates the following: a high degree of atmospheric humidity in conjunction with high soil temperature; a sufficiency of lime; an abundant and suitable fungous flora; and the nature of the detritus, sparsely distributed foliage, and young needles being more readily attacked than dense layers.

It is pointed out that transitional forms of humification between the two types above described, namely, decomposition (mycocriny and anthracriny) and peat formation (anthrageny), may occur.

The relatively satisfactory development of many kinds of trees on dry peat or other humus soils in which there is no progressive decomposition is explained by their capacity for mycotrophy, i. e., the assimilation through the roots of pure organic nutriment from humus-forming detritus with the help of associated fungi. Humus substances appear to be most readily attacked and decomposed in the incipient stages of humification, and mycorrhiza-forming fungi are generally found, therefore, in the uppermost humus layer, consisting of fresh detritus.

The physiological significance of mycorrhiza is discussed briefly and the functions of root hairs and fungous hyphae in such associations analysed.

In the author's opinion, which is stated to be based on numerous personal observations and experiments, the benefits which accrue to forest trees from symbiosis with mycorrhiza-forming fungi (excluding the nodule-forming association found in *Elaeagnus*, *Alnus*, and *Casuarina*, in which nitrogen-fixation occurs) consist solely in the presentation of all the requisite food-stuffs in the form of organic solutions.

In the concluding sections of the work the author discusses at some length the importance of mycocriny, anthracriny, and mycotrophy, as opposed to anthrageny, from a sylvicultural standpoint. It is pointed out that trees well provided with mycorrhiza are far better adapted to unfavourable climatic and soil conditions than those devoid of fungous symbionts. Suggestions are made for promoting the decomposition of humus by biological methods.

HUDIG (J.). **Ueber die Kalkbedürfigkeit unserer Sandböden.** [The lime requirements of our sandy soils.]—*Deutsche landw. Presse*, li, 20, pp. 218–219, 6 figs., 1924.

The use of the term 'grey speck' (Dörrfleckenkrankheit) for the 'moorkolonial' disease, originally described from Holland, is deprecated as misleading, since many of the plants suffering from this disturbance show no spots at all.

he causes of the disease in question [see this *Review*, iii, pp. 24, 425] are briefly recapitulated, together with those of the so-called 'Hooghalen' disease [see this *Review*, iii, p. 426], which has arisen as a consequence of the acid fertilizers applied to cure the former. The 'moorkolonial' disease is stated to be rapidly disappearing in Holland as the result of treatment with manganese.

The results of the author's investigations of the requirements in lime and fertilizers of Dutch sandy soils with a P_H value of 5·7 are summarized, and details of the most suitable treatment of these soils for the growing of particular crops are given.

KUNKEL (L. O.). **Histological and cytological studies on the Fiji disease of Sugar Cane.**—*Bull. Exper. Stat. Hawaiian Sugar Planters' Assoc.*, Bot. Ser., iii, 2, pp. 99–107, 5 pl., 1 fig., 1924.

These studies on Fiji disease of sugar-cane are stated to have been undertaken at the suggestion of Dr. H. L. Lyon, to whom the author is indebted for notes and for a large quantity of preserved material.

An examination of the tissues of the terminal buds of numerous diseased canes has shown that small groups of infected cells, containing deeply staining, spherical or oval bodies, frequently occur in the phloem a short distance behind the growing point. In the earliest stages minute groups of diseased cells are seen just below the growing point in tissues undergoing differentiation into vascular bundles, and frequently in the procambium strands also, far in advance of the tracheids and sieve-tubes. They have never been observed in the undifferentiated bud tissues, but similar groups of infected cells occur in the phloem of young leaves. Apparently the disease-producing agent travels through the bundles, probably passing out along the veins with the formation of each successive leaf and producing galls at irregular intervals.

The young galls, which are usually fusiform and much elongated, always occur on the under side of the leaves owing to their origin in the phloem. At a certain stage in the maturity of the gall, the surrounding cells, in the tissues normally producing the sclerenchymatous sheath and in portions of the phloem, enlarge and assume the appearance and staining reactions of tracheids. Their walls become thickened (mostly by means of reticulate, fibrous bands) and lignified, and the cells themselves become hard and woody. The infected tissues are thus more or less completely enclosed in a woody covering.

There is stated to be no evidence of direct nuclear division in infected gall cells, but stages in mitotic division have been observed in a number of sections.

The intracellular bodies of Fiji disease [see this *Review*, i, p. 187 and ii, p. 234] are readily distinguished from cell organs by the facility with which they take up aniline stains. In young galls they appear to occupy a vacuole in the cytoplasm of the host cell. The dimensions of the intracellular bodies were found to vary from an average of about 5 μ to an average of 25 or 30 μ

in different galls. Usually only one body occurs in each diseased cell.

Good evidence of the division of the bodies is stated to be available. Before division the body assumes a position near the host cell nucleus, where it becomes much elongated and divides by constriction in a plane parallel to the short axis of the host cell.

The bodies are composed of a deeply staining, granular material, and have a coarse, reticulate structure, many containing vacuoles and some showing fairly large, deeply staining granules. Appendages, usually rather short and with blunt rounded ends, are also of frequent occurrence; they are often more hyaline than the main part of the body. They may also be long, slender, and with a wavy outline. With approaching maturity the bodies assume a somewhat different aspect, the reticulate structure gradually disappearing. Organs resembling nuclei may be seen at this stage in many of the bodies, although it has not been possible to distinguish nuclei in the bodies during division.

In old galls the bodies are generally much elongated, filling a considerable part of the host cell, and showing a cleft or split at one end. Sometimes the contents of old bodies become divided, the separate portions resembling cysts. The manner in which the division occurs has not yet been determined, and sufficient evidence has not been obtained to justify any decision as to the nature of these intracellular bodies beyond that they are associated with the disease and appear to have the characters of a parasitic organism.

KUNKEL (L. O.). **Studies on the mosaic of Sugar Cane.**—*Bull. Exper. Stat. Hawaiian Sugar Planters' Assoc.*, Bot. Ser., iii, 2, pp. 115–167, 19 figs., 1924.

In this paper the author emphasizes certain important biological facts with regard to mosaic disease of sugar-cane.

Careful experiments on the Striped Tip and Hawaii 109 varieties have demonstrated that the spots on the leaves slowly increase in size and frequently fuse together. Most of the spots which later constitute the chlorotic areas are already present on the leaf when it first becomes green. New spots, however, have sometimes been observed to arise in the normal green tissues as the leaves unroll from the spindle.

The lesions caused by the disease occur not only as cankers in the rind but also in the deeper tissues. The author's observations show that discoloration and necrosis in mature inner stalk tissues are constant symptoms of the later stages of the disease. In the inner, immature tissues of the internodes of diseased stalks, small, opaque, whitish, elongated pockets may be seen. Many of the cells in the infected areas contain intracellular bodies similar to those formed in the inner stalk tissues of mosaic maize plants [see this *Review*, i, p. 194]. These cells, as well as a considerable number devoid of the bodies, die and collapse at an early stage in the development of the pockets, the extent to which disruption occurs varying, however, in different sorts of cane and even in individuals of the same variety. There is a tendency for such pockets, which may reach 5 mm. in diameter and several cm. in length, to be

grouped immediately beneath the rind (2 to 5 mm. deep), but they may occur in any part of the stalk tissue.

The statement that diseased seed-pieces always give rise to diseased stools has not been found to hold good in Hawaii, where infected cuttings, especially of the Striped Tip and Yellow Tip varieties, frequently produce healthy plants.

Most, if not all, of the natural spread of mosaic in Hawaii is believed to be attributable to *Aphis maidis*. The disease can also be transmitted by mechanical means. An experiment was carried out with six healthy Striped Tip plants, into the wounded leaves of which was pressed undiluted juice from the leaves and upper joints of diseased Lahaina canes. Five other healthy Striped Tip plants were inoculated with the juice of healthy Lahaina plants. Five of the six plants inoculated with the juice from diseased canes contracted mosaic, all the controls remaining healthy.

The following grasses are subject to mosaic disease in Hawaii: bristly fox-tail grass (*Chaetochloa verticillata*), goose grass (*Eleusine indica*), crab grass (*Syntherisma pruriens*), Sudan grass (*Andropogon sorghum sudanensis*), wonder forage grass (*A.* sp.), Tunis grass (*A. sorghum virgatus*), and Guatemala grass (*Tripsacum laxum*). Cross-inoculation tests have not yet been made with goose, crab, Tunis, or Guatemala grasses, although the disease on these plants is probably identical with that on sugar-cane.

The hypothesis that full sunlight may have an inhibitory action on the causal agent of mosaic was tested by removing the old leaves and leaf sheaths and exposing the young leaves to the direct rays of the sun during their development. Leaves so exposed were found to remain healthy and sound leaves could be produced at will on diseased stalks.

Mosaic has been observed to be a predisposing cause to attack by red rot (*Colletotrichum falcatum*) on leaves of the Striped Tip and Yellow Tip varieties.

The recovery of diseased stools of certain varieties has frequently been observed. In some cases the diseased shoots may begin to produce healthy leaves; later on the old diseased leaves die and fall. Such stools, therefore, may eventually become healthy. In other cases none of the diseased shoots actually recover, but they remain small and become overgrown by healthy new shoots. The diseased shoots ultimately die, and the stool may then remain healthy till maturity. After the harvesting of an infected crop, the stools in certain cases may produce only healthy shoots. Notes are given on individual cases illustrating these methods of recovery.

A careful determination of losses from mosaic on a number of varieties is given. The total weight of Badila cane from 240 hills planted with diseased 'seed' was 1196 lb. as compared with 5466 lb. from the same number of hills planted with healthy 'seed', the average weight of cane per hill being 9·9 and 45·5 lb. respectively. The corresponding figures for Lahaina were a total of 1382 lb. from the diseased hills and 4947 lb. from the healthy (11·5 and 41·2 lb. per hill respectively); for Striped Tip 941 and 5386 lb. (7·8 and 44·8 lb. per hill); and for Yellow Caledonia 2470 and 8613 lb. (20·5 and 71·7 lb. per hill). Striped Tip and Yellow Tip were found to

be very susceptible to infection but showed a high degree of recovery. Yellow Caledonia and Badila are resistant to infection but suffer severely when this occurs. Lahaina shows little recuperative ability and Demerara 117 none at all. Hawaii 109 and Demerara 1135 are moderately resistant and show great capacity for recovery, particularly the last named.

PRITCHETT (G. H.). **Points from Cane affected with mosaic disease versus points from healthy Cane at Hacienda Soledad owned by Mr. Jose Yusay.**—*Sugar Centr. and Planters' News*, v, 5, pp. 243–247, 2 diag., 1924.

Details are given of an experiment by a planter in the Philippines to test the effect of planting, under comparable conditions, cane points from healthy and mosaic-diseased plants respectively. A very distinct difference in germination, growth, and development was observed between the healthy and mosaic points, the former germinating well and growing robustly while the latter were feeble and stunted. The average yield from the healthy points was 41·5 tons of cane per hect. and that of the mosaic only 17·25 tons. The plots planted with healthy points gave an average yield of 71·15 piculs of sugar per hect. while the mosaic plots only produced 33·00 piculs per hect.

AGEE (H. P.). **Resistance to disease and adverse conditions by hardy Sugar-cane types.**—*Louisiana Planter*, lxxii, 4, pp. 75–76, 1924.

In discussing the types of sugar-cane immune from root rot, the author points out that the four mentioned by Earle (*Journ. Dept. Agric. Porto Rico*, iv, p. 3, 1920), namely, Kavangire, P.O.J. 36, P.O.J. 105, and P.O.J. 234, all belong to the Ganna North Indian group. The Uba variety, which is probably identical with Kavangire, is being extensively grown at present in Natal, Porto Rico, Cuba, and Jamaica. Kavangire has not been positively identified in Hawaii, and is frequently confused with Zwinga, another highly resistant variety. Work is in progress at the Cuba Station in the production of a so-called 'super-Uba' by crossing Uba with Crystalina. Five hybrids have been obtained at the Hawaii Station between Uba and D. 1135 and the first few months of growth have given promising results.

In the Argentine the declining cane industry of Tucumán (a decline chiefly due to mosaic) has been completely rehabilitated by the varieties P.O.J. 36 and P.O.J. 213, each of which covers an area of about 100,000 acres. In Formosa P.O.J. occupies an area of 56,000 acres, having entirely replaced the Rose Bamboo variety, while in Egypt P.O.J. 105 has become a commercial cane.

Early in 1923 it was decided to grant permits for the introduction into Hawaii, subject to stringent quarantine regulations, of the varieties P.O.J. 36, P.O.J. 213, P.O.J. 234, and P.O.J. 979. The first of these shows considerable resistance to mosaic and root disease and the second is highly resistant to both these diseases and also to top rot, to which P.O.J. 36 and P.O.J. 234 are somewhat susceptible. The latter cane is fairly resistant to mosaic and root

disease. P.O.J. 979 is stated to be one of the best Java seedlings grown in Tucumán.

Dr. E. W. Brandes has sent to Washington a number of valuable cane varieties from the East, including some recent Java hybrids showing great resistance to root rot and mosaic. The Chunnee and its hybrid progeny are stated to be susceptible to mosaic but suffer little damage from it.

PETCH (T.). **Monotospora oryzae B. & Br.**—*Journ. Indian Bot. Soc.*, iv, 1, pp. 21–24, 1 fig., 1924.

Specimens of rice suffering from a disease known as 'red stalk' from the Jaffna district of Ceylon bore traces of the fungus *Monotospora oryzae.* It appears improbable, however, that this fungus is the cause of the disease in question.

The author describes the fungus in great detail and gives his reasons for transferring it to the genus *Nigrospora* as *N. oryzae.*

GONZÁLEZ FRAGOSO (R.). **Ustilagales de la flora española existentes en el herbario del Museo Nacional de Ciencias Naturales de Madrid.** [Ustilaginales of the Spanish flora contained in the herbarium of the National Museum of Natural Sciences of Madrid.]—*Bol. R. Soc. Esp. Hist. Nat.*, xxiv, 3, pp. 116–127, 1924.

Amongst the 61 smuts of the Spanish flora represented in the herbarium of the National Museum of Natural Sciences, Madrid, are *Ustilago maydis* [*U. zeae*] on maize, *U. sorghi* [*Sphacelotheca sorghi*] on sorghum, *U. panici-miliacei* on *Panicum miliaceum*, *Tilletia levis* on wheat, *Urocystis cepulae* on onion and garlic, and various other species of more general European distribution.

A short bibliography is appended.

PETRAK (F.). **Mykologische Notizen. VII.** [Mycological Notes. VII.]—*Ann. Mycol.*, xxii, 1–2, pp. 1–182, 1924.

These pages contain the author's notes numbered 301 to 400. Numerous species, mostly of Fungi Imperfecti and Ascomycetes, are discussed. No. 305 deals with *Didymellina pinodes* (Berk. & Blox.) v. Höhn., the perithecial condition of *Ascochyta pisi* Lib. and the cause of a well-known disease of peas. The fungus was formerly known as *Mycosphaerella pinodes* (Berk. & Blox.) Stone, but was later considered by von Höhnel as a *Didymella* which lacked paraphyses and for which he created the new genus *Didymellina.* The author has now had abundance of fresh material and finds that in the young stage paraphysis-like structures can be easily demonstrated. It agrees with the typical species of *Didymella* in (1) the structure of the ascus; walls thin, not thickened at the apex; (2) ascosporal characters; spores obtuse at both ends, mostly asymmetrical or curved; and (3) the presence of *Ascochyta* pycnidia, which have never been shown to belong to the life-cycle of any good *Mycosphaerella.* He renames the fungus *Didymella pinodes* (Berk. & Blox.) Petr., and considers that *Mycosphaerella lethalis* should also be referred to this genus. The genus *Didymellina* v. Höhn. should be suppressed.

BERNARD (C.). **Verslag van het Algemeen Proefstation voor Thee over het jaar 1923.** [Report of the General Experiment Station for Tea for the year 1923.]—*Meded. Proefstat. voor Thee*, lxxxvii, 24 pp., 1924.

The following references (pp. 9–13) are of phytopathological interest.

Owing to favourable meteorological conditions the damage to the Java tea plantations is stated to have been very slight during the period under review. Incipient attacks of *Poria* were averted by the digging of circular isolation trenches and the application of lime. In one plantation *Armillaria* [*mellea*] was found to have spread to the tea roots from branches which had been buried after pruning. Among the green manure plants, *Tephrosia* was attacked by 'djamoer oepas' [*Corticium salmonicolor*] and a species of *Sclerotium*, the latter also occurring on *Crotalaria*.

ANDERSON (P. J.). **Overwintering of Tobacco wildfire bacteria in New England.**—*Phytopath.*, xiv, 3, pp. 132–139, 1924.

The results of three years' investigations on the overwintering of tobacco wildfire (*Bacterium tabacum*) show that, under New England conditions, the organism survives best in fairly dry situations, such as on cured leaves in the barn, leaves on plants left standing in the field or thrown on the ground too late to rot, and on boards, sashes, and dry fragments of pods. Conversely its vitality is reduced in humid situations.

The following measures are accordingly recommended for control. All leaves and stubble of infected crops should be ploughed under as soon as the tobacco is removed (before sowing the cover crop), and no diseased plants or suckers left in the field during the winter. It is most important to prevent the escape of contagious material from the barns where diseased tobacco has been hung, this being a frequent source of spring infections. Sashes, planks, &c., stored in barns with diseased tobacco should be sterilized. There is stated to be no advantage in sterilizing seed saved from healthy pods. By due observance of the above precautions it should be possible to grow a clean crop of tobacco even on a field which grew a diseased one the previous year.

JOHNSON (J.), SLAGG (C. M.), & MURWIN (H. F.). **Host plants of Bacterium tabacum.**—*Phytopath.*, xiv, 4, pp. 175–180, 2 pl., 1924.

In the course of investigations at Wisconsin on the overwintering of wildfire of tobacco (*Bacterium tabacum*) a study was made of other probable hosts of the organism.

Inoculation experiments with and without wounding were successfully carried out on 12 species of *Nicotiana* and on 7 other members of the Solanaceae, namely, pepper (*Capsicum annuum*), eggplant (*Solanum melongena*), tomato, potato, ground cherry (*Physalis grandiflora*), deadly nightshade (*S. nigrum*), and Jimson weed (*Datura stramonium*). Pepper and eggplant were particularly susceptible.

Heavy infection was secured on four members of the Cucurbi-

taceae: muskmelon (*Cucumis melo*), cucumber (*C. sativa*), watermelon (*Citrullus vulgaris*), and pumpkin (*Cucurbita pepo*).

Among the 13 Leguminosae artificially infected the most typical symptoms were exhibited by beans (*Phaseolus vulgaris*) and peanut (*Arachis hypogaea*). This family, like the Gramineae, of which 11 species were infected, appears less susceptible than the preceding families, but most of the members contracted the disease without previous wounding of the tissues.

Seven of the Cruciferae, including cabbage, turnip, radish, and mustard (*Brassica alba*) became infected, the last-named severely.

Of the Compositae, 6 species, including sunflower (*Helianthus annuus*), became infected; of the Polygonaceae, 5; of the Chenopodiaceae, beets and spinach; of the Malvaceae, cotton and mallow (*Malva rotundifolia*); of the Labiatae, 3; and 13 other species belonging to different families, including tulip, barberry, rose, and maple (*Acer saccharinum*) seedlings. Fully 90 per cent. of the plants inoculated gave successful results, and this host list could probably be greatly increased by further trials.

THOMAS (H. E.). **Tobacco wildfire and Tobacco seed treatment.**—*Phytopath.*, xiv, 4, pp. 181–187, 1 fig., 1924.

During 1923 several experiments were carried out on various methods of seed treatment for the control of tobacco wildfire (*Bacterium tabacum*).

It was found that seed treated in mercuric chloride 1 in 1,000 germinated almost or quite as well, when sown on soil or thinly on filter paper on damp sand in moist chambers, as untreated seed. No germination was obtained, however, either at 26° or 33° C., when seed similarly treated was held in bulk in muslin or cheesecloth bags, the practice of germinating the seeds in bulk being general in New York on account of the shortness of the growing season. Untreated seed in bulk germinated less well than samples from the same lots germinated in Petri dishes.

No appreciable injury to the seed resulted from the following treatments: 2 and 5 per cent. copper sulphate for 20 minutes with subsequent washing in lime water; 10 per cent. potassium dichromate for 10 minutes; 5 per cent. potassium permanganate for 20 minutes; and 10 per cent. sulphuric acid for 5 minutes.

Both treated and untreated seed germinated well at 26° and below, but poorly at 33°. Neither rapid drying of wet seed in direct sunlight nor slow drying in the laboratory impaired germination under the conditions of the above experiments.

VALLEAU (W. D.). **The infection of Tobacco plant beds by spitting.**—*Science*, N.S., lix, 1528, pp. 337–338, 1924.

A case is recorded from Kentucky of the infection of tobacco seed-beds with wildfire and angular leaf-spot (*Bacterium tabacum* and *Bact. angulatum*) through the practice of chewing and expectorating tobacco leaves from the previous year's crop.

Angular leaf spot was present in Kentucky in 1923 to the extent of 90 per cent.; in every case in which the fields were healthy the grower did not chew tobacco. Other evidence showing the importance of this source of seed-bed infection is also available.

Commercial tobacco, raw or manufactured, may also have played a part in the dissemination of the disease, though most of the data point to the natural leaf of the previous crop as the chief source of infection in this way.

HOFFMANN. **Krankheiten an Tabaksämlingen.** [Diseases of Tobacco seedlings.]—*Deutsche landw. Presse*, li, 23, pp. 285–286, 1924.

Tobacco seedlings in the southern Palatinate [Germany] are stated to have suffered severely from a fungous disease resembling *Peronospora* [*Plasmopara*] of the vine and greatly favoured by the abrupt transition from the cold, wet spring to hot summer weather at the end of May.

Pale spots appeared on the leaves which gradually lost colour and shrivelled. The first symptoms were usually noticed at the tip or round the edge of the leaf, afterwards spreading rapidly over the whole surface. Certain symptoms [unspecified] are also stated to be reminiscent of *Phytophthora*.

Suggestions are made for the control of the disease by cultural methods, including the use of fresh seed-beds, protection of the seedlings during cold weather, watering when the sky is overcast, plentiful use of fertilizers (not uniformly nitrogenous), and possibly the employment of a seed stimulant.

SCOTT (I. T.). **The influence of hydrogen-ion concentration on the growth of Fusarium lycopersici and on Tomato wilt.**—*Missouri Agric. Exper. Stat. Res. Bull.* 64, 32 pp., 10 graphs, 1924.

An investigation was conducted to determine the influence of hydrogen-ion concentration on the growth and infectivity of *Fusarium lycopersici* [see above, pp. 561, 599].

The paper opens with accounts of the crop losses, of the work of earlier investigators, of the morphological and cultural characters of the fungus, the symptoms of tomato wilt, and its relation to various external factors.

The cultures used in the studies were from a monospore strain isolated in September 1921 from a wilted tomato plant at the Missouri Experiment Station. A series of 4 experiments, each consisting of 3 sets of 15 cultures, were made, using the same basic nutrient solution throughout (KNO_3, 3 gm.; $MgSO_4.7H_2O$, 0·75 gm.; KH_2PO_4, 3·64 gm.; K_2HPO_4, 6·96 gm.; $FeCl_3$, trace; dextrose, 10 gm.; and distilled water to make 1,000 c.c.), the only variations being the halving of the amount of phosphates in experiment 1 and the addition of the acid and basic radicles in the acids and alkalies used in adjusting the reactions of the solutions. The only constantly variable factor was the concentration of the hydrogen-ions. Growth was estimated as dry weights of the mycelium.

The results indicate that the acid solutions became more alkaline and the alkaline more acid during the growth of the fungus. Such changes in reaction may be due to excretions by the fungus or to the selective absorption of ions.

The growth curves show that *F. lycopersici* will grow over a wide range of acidities from P_H 2·4 to P_H 9·4. Considerable

variations in the amount of growth in the different series were evident, the variations being due probably to differences in the amount of inoculum and differences in the composition of the nutrient solution. On the culture medium used, the maximum growth took place at an average of P_H 4·5 to 5·3, followed by a minimum at an average of P_H 5·25 to 5·8, and with a second maximum in most cases at average P_H 5·85 to 6·35. The general agreement between the curves indicates that the differences in growth were wholly or largely due to variations in the hydrogen-ion concentrations.

A single soil experiment was carried out with the object of determining the effect of soil reaction on the infection of tomato by *F. lycopersici.* Tomato plants were grown in inoculated soil adjusted to various hydrogen-ion concentrations. The minimum infection was found to occur at average P_H 6·4 to 7·0, which is distinctly higher than the value at which minimum growth took place between the two maxima found in culture solutions. Pronounced wilting of the plant, however, may not take place until several weeks after infection has occurred and the reaction of the soil at the time of infection is probably nearer the initial reaction than the average.

Whether it is possible in a field to change the reaction of the soil so as to produce a reaction unfavourable for infection, or to use soils with natural reactions unfavourable to tomato wilt, are questions requiring further experimental work before they can be answered.

SHAPOVALOV (M.) & LESLEY (J. W.). **The behaviour of certain varieties of Tomatoes towards Fusarium-wilt infection in California.**—*Phytopath.*, xiv, 4, pp. 188–197, 2 pl., 1924.

The reaction of a number of varieties of tomatoes to the wilt fungus (*Fusarium lycopersici*) has been tested in California, where the disease causes very severe losses (from 5 to 85 per cent. of the crop).

Two methods of testing [details of which are given] were used, namely, artificial inoculation with pure cultures of the fungus and natural field infection. In the former method two distinct cultures of *Fusarium* were employed, both isolated from wilted plants in California, only one of which, however, proved to be virulent.

Three plots in widely separated localities in Southern California, involving both methods of testing, gave consistent results as regards varietal reaction. Norton proved resistant in all three places, while the same was true of Norduke, Marvel, and a Californian selection from Stone (23·087) in both localities where they were tested. Most of the varieties bred for wilt resistance at various experiment stations, together with Livingston's Globe proved resistant to wilt when planted on badly infected soil in California.

PRITCHARD (F. J.) & PORTE (W. S.). **The relation of temperature and humidity to Tomato leaf spot (Septoria lycopersici Speg.).**—*Phytopath.*, xiv, 3, pp. 156–165, 1 pl., 9 maps, 1924.

The temperature relations of the leaf spot fungus of tomatoes

(*Septoria lycopersici*) were determined in culture by means of a Paul Altmann's incubator. The culture media used were cornmeal and cornmeal agar. The minimum temperature for growth was found to be 35°, optimum 77°, and maximum 94° F. The corresponding figures for sporulation were 59°, 77°, and 80·5°.

Opinions vary as to the optimum temperature for the growth of the host, but the writers agree with A. Mayer (of the Government Experimental Greenhouses, Arlington, Virginia) that 60° to 65° by night and 65° to 70° by day is approximately ideal. The yields in different States showed that average crops of 5 tons or more per acre were obtained where the average daily temperature was 65° or less during the growing season. The lowest yields came from localities averaging 72° or above.

Losses from *S. lycopersici* are stated to be heaviest in the Middle Atlantic and Middle Western States, reaching a maximum in the Atlantic Coast States. The disease is of slight importance in the north and south and apparently absent from the Pacific Coast region. The chief development occurs in a temperature belt of 73° to 78°.

The cultivation of earlier crops of tomatoes is one method of escaping the attacks of *S. lycopersici*, but this practice is open to certain objections, including the risk of wilt [*Fusarium lycopersici*]. Effective measures should be taken to prevent the overwintering of the fungus. Old tomato plants should be ploughed under in the autumn or early spring. Experimental data, to be published later, show that the fungus cannot persist in the soil. As various solanaceous weeds are susceptible to *S. lycopersici*, these should be excluded from tomato fields. Seedlings from infected seed-beds and from unknown sources should be avoided even though they appear healthy.

Povah (A.). **Hypoxylon Poplar canker.**—*Phytopath.*, xiv, 3, pp. 140–145, 1 fig., 1924.

A new canker of poplars caused by *Hypoxylon pruinatum* and affecting *Populus tremuloides*, *P. grandidentata*, and *P. balsamifera* is reported from New York, Michigan, and Maine. In Essex County, New York, over 36 per cent. of the aspens were infected and over 26 per cent. killed by the disease. Young trees have been found to be more susceptible than older ones, no infections occurring on those exceeding six inches in diameter.

The fungus produces on the bark small, slightly discoloured, and somewhat depressed areas, delimited by vertical cracks. The sapwood is blackened, the discoloration extending vertically in attenuated points, between which occur fans of whitish mycelium. Ultimately the trees are killed by girdling.

Moir (W. S.). **White Pine blister rust in western Europe.**—*U.S. Dept. of Agric. Bull.* 1186, 32 pp., 15 figs., 1924.

A full account is given of the history, development, and distribution of white pine blister rust (*Cronartium ribicola*) in Europe, together with a summary of the present position of the disease in Scandinavia, Great Britain, France, Belgium, and Germany, and an outline of the control measures in force in each country. A list of nearly 50 susceptible species of *Ribes* is given, of which 22 occur in

America, and a brief section is devoted to the economic aspect of the disease in the United States. The future position of *P. strobus, P. lambertiana* (the most valuable commercial timber tree on the Pacific Coast), *P. monticola, P. flexilis,* and others, is stated to be seriously threatened by the presence of blister rust, and vigorous action is required to control the disease in the United States.

BUCHHEIM (A.). **Zur Kenntnis des Eichenmehltaus.** [Contribution to the knowledge of Oak mildew.]—*Zeitschr. für Pflanzenkrankh.*, xxxiv, 1–2, pp. 1–11, 3 figs., 1 diag., 1924.

During the summer of 1922 the perithecia of the oak mildew fungus occurred on a most extensive scale in central and north Russia. Marked variations [details of which are given] were observed in the measurements of the perithecial elements. On the whole, the Moscow perithecia bear a closer resemblance to *Microsphaera alni* than those found in France in 1911 (*Comptes Rendus Acad. Sci.*, 154, p. 1302, 1912) but on biological grounds the author considers it advisable to retain the name *M. quercina.*

Inoculation experiments on beech branches with the conidial stage of the fungus from oak gave positive results, and in one case it was also possible to infect oak with the fungus from beech. No appreciable differences were observed between the conidia on oak and those on beech, and Neger's view of the identity of the oak and beech mildew is thus confirmed.

In a postcript the author mentions the discovery (communicated in correspondence) of the perithecia of oak mildew by Dr. Blumer at Berne. The present tendency to perithecial formation in various parts of Europe is considered to afford an indication of the approaching conclusion of the developmental cycle of the fungus, rather than to be an expression of the influence of external conditions.

DUFRÉNOY (J.). **La maladie du Châtaigner dans l'Aveyron et le Cantal.** [The Chestnut disease in the Aveyron and Cantal Departments.]—*Office Agric. Rég. du Massif Central, Clermont-Ferrand, Bull.* 3, 11 pp., 4 pl., 1924.

In this paper the geographical distribution of the ink disease of chestnuts [see this *Review*, ii, p. 188; iii, p. 245] in the Departments of Aveyron and Cantal is given.

The characters of the disease are described and the author states that two forms have been recognized: the chronic form which generally occurs in rough soils and develops slowly, and the 'lightning' form, or 'apoplexy', which occurs especially in clay soils.

To test the degree of resistance of the Japanese varieties, these have been planted in the districts where the disease occurs. It is pointed out, however, that other causes may bring about the death of young trees, e. g., root rot produced by *Armillariella* [*Armillaria*] *mellea*, the development of which is favoured by planting too deep, and also infection by *Coryneum modonium*, a very destructive parasite which invades the tree through wounds.

The following rules for the planting of chestnuts, especially exotic varieties, are given: (1) the roots must not be left exposed to the air, especially in windy or cold conditions, even for a short

period; (2) the collar must not be planted at a greater depth than 10 cm.; (3) wounds must be treated with mastic or iron sulphate solution; (4) the stem should be wrapped in straw for protection against the sun; (5) the trees must be protected against cattle. With regard to the planting of indigenous chestnuts, it appears that trees growing near the high altitude limit (about 1,000 m.) in sufficiently deep soils are immune. It is also stated that the application of rapidly acting fertilizers may help trees to overcome the chronic form of the disease.

G. **Il male dell' inchiostro, i cedui, il fuoco e i maiali.** [Ink disease, copses, fire, and swine.]—*Il Coltivatore*, lxx, 12, pp. 371–373, 1924.

In this brief popular account of the ink disease of chestnuts [see last abstract] the writer advocates burning the fallen foliage of affected trees, thereby simultaneously destroying the spores of the fungus and sterilizing the soil. It has frequently been observed that the disease, which persists through the winter in fallen chestnuts, does not occur in copses where the trees do not bear fruit. It is further suggested that swine, which feed readily on chestnut husks, should be given free access to infected forests in order to consume the husks and thereby restrict the spread of the disease.

Nowotny (R.). **Ueber die Bedeutung der wasserlöslichen Bestandteile in Imprägnierteerölen.** [The importance of the water-soluble constituents in coal-tar oils for impregnation.]—*Zeitschr. angew. Chemie*, xxxvii, 5, pp. 59–61, 1924.

The author calls attention to the work of Bateman (*Proc. Amer. Wood Preserv. Assoc.*, 1920 and 1921) and others, who have shown that the protective action of coal-tar oils on timber is due to the antiseptic properties of their water-soluble constituents, especially the high-boiling phenols and bases, and not to the non-soluble oleaginous substances. It was found, for instance, that the addition of 20 per cent. of this so-called 'indifferent' or 'barren' oil, which constituted 40 per cent. of the whole, to cultures of *Fomes annosus* failed to arrest the development of the fungus to any appreciable extent. The indifferent oils, however, are indispensable to the complete efficacy of coal-tar products, since they serve as carriers of the poisonous constituents and also prevent an excessive flow of water into the timber.

Bray (M. W.) & Andrews (T. M.). **Chemical changes of groundwood during decay.**—*Indus. & Engin. Chem.*, xvi, 2, pp. 137–139, 1924.

Experiments were conducted at the Forest Products Laboratory, Madison, Wisconsin, to ascertain the chemical changes undergone by groundwood infected with pure cultures of specific organisms. The materal for testing consisted of 70 per cent. spruce and 30 per cent. balsam in a fresh and clean condition. One-hundred-gm. samples were placed in sterilized air-tight jars, which were inoculated, in sets of three, with pure cultures of *Fomes roseus*, *Lentinus*

lepideus, *Peniophora tabacina*, and an unidentified fungus, all isolated from pulp or pulpwood.

The three jars of each set were opened at the end of 6, 9, and 12 months, respectively, while one, containing the culture of an unidentified fungus, was allowed to stand for three years. The losses were found to range from 10·3 to 27·12 per cent. after the first six-monthly period of infection. At the end of three years the unidentified fungus had caused a loss of 62·4 per cent.

It has been shown by several investigators [references to whose work are given] that decayed wood contains a higher percentage of lignin than sound material of the same species, and that wood attacked by organisms acting selectively on the lignin contains relatively more cellulose than the corresponding sound wood. In the present investigations the apparent increase of lignin varied, with the nature and time of action of the organisms, from 24 to 41·3 per cent. Comparison with samples of the original sound groundwood, however, showed that no real increase in the lignin had taken place, but that it had either remained constant or decreased slightly (3 per cent. after three years in the wood attacked by the unidentified fungus). This loss was virtually explained by the decrease in the methoxyl content of the groundwood, namely, 2·8 per cent., indicating a partial hydrolysis of the methoxyl groups of lignin during decay.

The greatest losses due to infection with these wood-destroying fungi occurred in the cellulose content, which in the original samples amounted to 60 per cent. After six months' storage the cellulose content of the sample infected with the unidentified organism was reduced to 26·8 per cent., while after one and three years respectively the corresponding figures were 10·9 and 6·05 per cent. The severity of the infection caused by the unknown fungus is believed to be due to the optimum conditions prevailing during the experiments for this type of brown rot. Not only the quantity but also the quality of the cellulose was markedly affected by most of the organisms.

The fact that the lignin content remains practically intact suggests the possibility of preparing pure lignin for chemical investigation by exposing wood to the action of fungi instead of treatment with strong mineral acids.

Even in cases of extreme decay part of the pentosans remained undecomposed.

The solubility of decayed groundwood in hot water and one per cent. sodium hydroxide, calculated on equal weights of the original sample, increased to a maximum and then decreased rapidly with the decline of the cellulose content. Maximum solubility was obtained when the cellulose content was reduced to approximately 25 per cent.

Rue (J. D.), Miller (R. N.), & Humphrey (C. J.). **Decayed wood for sulphite pulp.**—*Pulp and Paper Mag. Canada*, xxii, 4, pp. 93–100, 7 figs., 1924.

A preliminary survey has been made at the Forest Products Laboratory, Madison, Wisconsin, of the utility for sulphite pulp of spruce and balsam infected with a few of the most important types

of wood-destroying fungi, including *Fomes pinicola*, *Polystictus abietinus*, mixed feather rots (caused by several fungi), and hemlock heart rot (cause under investigation) on the latter, and *Trametes pini* on the former. All the fungi represented are prevalent in the balsam and spruce forests of Eastern Canada, the first two being especially found on trees killed by the budworm and other agencies.

The pulps obtained from these decayed woods and cooked for news grade sulphite were found, with the exception of that attacked by *T. pini*, to be not materially weaker than those from sound wood. The strength of the pulp from wood affected by *T. pini* was not so far below the normal commercial level as to preclude its use for newsprint. There may, however, be a discoloration of the pulp from infected wood, the darkening being roughly proportional to the degree of discoloration in the wood. The yields obtained from decayed wood, both on the weight and volume basis, were as a rule only slightly lower than those from sound material. Some correlation was observed between the degree of firmness of the wood and its pulping value, the highest loss in yield occurring in wood showing the most marked decrease of firmness. The density of the wood is not, in general, a reliable indication of its pulping value.

The solubility of the wood in one per cent. alkali may prove useful in the valuation of decayed pulpwood, but further investigations are necessary to establish this point. The lignin and cellulose contents of the wood, while not, in themselves, reliable indications of pulping values, may prove valuable in connexion with alkali solubility and degree of firmness.

MOLL. **Holzkonservierung und Schwammverhütung in landwirtschaftlichen Betrieben.** [Wood preservation and fungus prevention in agricultural structures.]—*Mitt. deutsch. Landw.-Gesellsch.*, xxxix, 19, pp. 344–345, 1924.

The protective treatment of wood against the attacks of fungi is discussed under three headings, namely, impregnation, immersion, and painting.

Impregnation with mixtures of corrosive sublimate and sodium fluoride by the methods practised at the so-called 'Kyanisierwerke' is expensive and suitable rather for large quantities of homogeneous timber, such as is used for bridges, sleepers, and sewage and electricity plant, than for agricultural constructions.

Immersion in an iron tank (the so-called American open tank) filled with carbolineum heated to 60° or 80° C. gives excellent results, more especially in the control of 'blueing' of coniferous timber [see this *Review*, ii, p. 185]. Fence posts, vine poles, and the like, may be immersed in barrels containing the same preparation. It is recommended that the wood should be allowed to cool in the vessel in which it has been treated. The large American sawmills are stated to be provided with 'soda dips', i.e., barrels filled with sodium fluoride, in which all the wood is immersed. In Germany, where the damage from 'blueing' is very considerable, the introduction of similar methods would be extremely valuable.

Painting is chiefly of use in the control of dry rot [*Merulius lacrymans*] in buildings, being less efficacious for outdoor purposes.

The best wood preservatives are stated to be carbolineum, the above-mentioned corrosive sublimate and sodium fluoride mixture, basilite, triolith, and Rütgers's schwammschutz [see this *Review*, iii, p. 242].

SAYRE (C. B.). **Recent developments in spraying and dusting vegetables.**—*Trans. Illinois State Hort. Soc.*, lvii (1923), pp. 360–365, 1924.

An account is given of some recently introduced sprays and dusts and their uses.

Soap Bordeaux (4 lb. copper sulphate, 2 lb. rosin fish-oil soap, 3 lb. quicklime, and 50 galls. water) is stated to be superior to standard Bordeaux for use on waxy or hairy leaved plants, owing to its greater adhesiveness.

The Pickering spray (containing saturated lime-water and 0·7 per cent. of copper sulphate) has been found to control late blight of potatoes [*Phytophthora infestans*] as well as 5–5–50 Bordeaux. It is, however, too caustic for plants with tender foliage, such as the apple and grape vine.

Reduced lime Bordeaux (3 lb. copper sulphate, $1\frac{1}{2}$ lb. lime, and 50 galls. water, or 4 lb. copper sulphate, 2 lb. lime, and 50 galls. water) is said to have proved superior to standard Bordeaux, in tests conducted by the U.S. Department of Agriculture, in the control of potato late blight.

Copper lime dust (16 per cent. by weight dehydrated copper sulphate, 20 per cent. calcium arsenate, and 64 per cent. hydrated lime) appears to be a very promising substitute for Bordeaux mixture in the control of certain fungous diseases, including leaf spot of tomatoes [*Septoria lycopersici*], fruit rot of eggplants [*Phomopsis vexans*], and downy mildew of cucurbits [*Pseudoperonospora cubensis*]. The cost of 100 lb. of this mixture (sufficient to cover $2\frac{1}{4}$ acres of eggplants or vine crops) is about $ 8.50.

BREMER (H.). **Untersuchungen über Biologie und Bekämpfung des Erregers der Kohlhernie, Plasmodiophora brassicae Woronin. 2 Mitteilung. Kohlhernie und Bodenazidität.** [Investigations on the biology and control of the causal organism of club-root of Cabbage, *Plasmodiophora brassicae* Woronin. Second Note. Club-root and soil acidity.]—*Landw. Jahrb.*, lix, 5, pp. 673–685, 1924.

In continuation of his earlier investigations on the biology and control of *Plasmodiophora brassicae* [see this *Review*, iii, p. 249], the author undertook a series of experiments to determine the effect of the hydrogen-ion concentration of the soil on spore germination.

Sections of infected cabbage roots were placed in five pots containing, respectively, heath soil without lime and the same with the addition of lime at the rate of 30, 60, 90, and 120 gm. per kg. By the end of four months a very high proportion of the spores had germinated both in the treated and untreated soils, notwithstanding an initial check in the former which was most marked after 35

days. The final P_H values were 5·4 in the control and 7·0 to 7·5 in the treated pots. Parallel tests were conducted with neutral soils (compost and sand).

The results obtained indicated that spore germination is not exclusively dependent on the hydrogen-ion concentration of the soil. For instance, in the most heavily limed heath soil total germination rose, during a period of about three weeks, from 50 to 90 per cent., whereas in compost with a reaction of only P_H 6·8 it remained unchanged at 0 per cent. Whilst no definite assertion can yet be made, it is considered highly probable that other soil factors than reaction affect the germination of the spores. The total quantity of lime in the soil was also shown to be by no means the decisive factor in the arrest of spore germination.

A test was made with sections of infected roots in test-tubes containing 10 c.c. of a phosphate buffer solution varying from P_H 5·4 to 8·0, to which was added 0·25 c.c. per tube of 0·45 per cent. corrosive sublimate solution. Above P_H 7·0 there was a very marked increase in the percentage of live spores in the presence of equal quantities of the sublimate; at P_H 8·0 the toxic effect of the latter was almost completely inhibited. It was further shown that a high temperature (45° C.) was least injurious at P_H 8·0. Thus the spores of *P. brassicae* are seen to be most resistant to harmful external influences in soils with a faintly alkaline reaction.

Discussing the origin of club-root epidemics, the author points out that the number of amoebae liberated and the percentage which effect infection are incalculably greater in acid soils than in neutral ones. In the absence of suitable hosts, however, the parasite is likely to be exhausted sooner in acid soils than in neutral ones. Wherever cabbage is planted on soils which have become acid through the excessive application of nitrogenous manures or through the withdrawal of lime by smoke gases, epidemics will necessarily follow infection.

In the author's opinion the complete extinction of the causal organism has little or no prospect of success owing to its practical ubiquity, the constant possibility of reinfection, e.g. by earthworms [see this *Review*, ii, p. 351], and the high degree of the resistance of the spores to the toxic action of disinfectants. The most promising method of control still appears to lie in the neutralization of the soil. The rapidity with which lime disappears from certain soils must be taken into account as well as the varying buffer action and diverse physical composition of different soils.

In certain cases, e.g., in frames and on excessively acid soils where the application of lime is unlikely to prove sufficiently drastic, the use of a disinfectant, such as uspulun, may be preferred, but owing to the expense such treatment cannot generally be employed on a large scale.

Lindfors (T.). **Bidrag till kännedomen om klumprotsjukans bekämpande.** [Contribution to knowledge of the control of club-root.]—*Kungl. Landtbr. Akad. Handl. och Tidskr.*, lxiii, 3, pp. 267–287, 2 figs., 1924.

The results of experiments conducted from 1920 to 1923 in the

control of club-root of *Brassica* species (*Plasmodiophora brassicae*) by means of lime or soda showed that this form of treatment does not give adequate protection where the disease is well established and where intensive cultivation of the same crop is continued.

In 1923 pot tests were undertaken to determine the influence of the hydrogen-ion concentration of the soil on the incidence of infection [see preceding abstract]. The reaction was adjusted by the addition of sulphuric acid, soda lye, or slaked lime; gypsum failed to alter the soil reaction to any appreciable extent. The results of the tests showed a marked decline in the percentage of infection corresponding with an increase of alkalinity in the soil reaction. Even at P_H 7·1 to 7·5 there was only 8·5 per cent. of disease, while at P_H 7·8 to 8·0 the plants were completely healthy.

In 1921 an experiment was carried out to test the value of lime and uspulun, together and separately [see also this *Review*, iii, p. 259]. White cabbage seedlings were grown in six plots of heavily infected soil (100 plants per plot) of which three received carbonate of lime at the rate of 10,000 kg. per hect. Half of each plot was watered with one quarter l. of a solution of 0·25 per cent. uspulun and three days later with a 0·1 per cent. solution. The average weight of the 67 heads in the unlimed plots receiving uspulun was 18 gm., that of the 78 heads in the plots receiving both lime and uspulun, 19 gm.; that of the 77 in the plots receiving lime alone, 13 gm.; and that of the 2 in the untreated controls, 0·4 gm. Further experiments in 1922 using lime, soda, and uspulun, with controls carried out in the plots used in the 1921 test, showed that the benefit derived from the liming in the first experiment persisted into the next year.

In 1923 comparative tests were conducted on Svalöv's Bangholm swedes with uspulun (5 gm. per 10 l. water), formalin, and a French preparation known as sulgine (100 gm. per sq. m.). Formalin and uspulun reduced infection by about 12 and 5 per cent. respectively, while sulgine had no effect. The highest yield was obtained from the plots treated with uspulun.

An experiment in varietal susceptibility was carried out on a large scale in 1923 on turnips and swedes planted in heavily infected clay soil. The most resistant varieties of turnips were Svalöv's Yellow Tankard, Dale's Hybrid, and Weibull's Sekel and Östersundom, the two last-named giving the highest yield. The various strains of Bortfeld were highly susceptible. The following varieties of swedes proved most resistant: Studsgaard Bangholm, Wilhelmsburger, Svalöv's Yellow Swedish, and Weibull's Swedish Smooth. The highest yields were given by Weibull's Imperial and Trondhjem, but these varieties, as well as Svalöv's and Weibull's Bangholm, were very susceptible to club-root.

For the control of the disease the author recommends the usual treatment with lime, a 4 years' rotation between root crops, the eradication of cruciferous weeds, and great care in the use of infected manure. Uspulun (0·25 per cent.) is recommended for growers on a small scale.

Décret sur l'organisation de l'inspection phytopathologique. [Decree regulating the organization of phytopathological inspection.]—*Ann. Sci. Agron.*, xli, 2, pp. 65–71, 1924.

A Presidential Decree of 24th November 1923 regulates the organization of the French phytopathological service, which is divided into two main branches, one occupied with the inspection of crops and the control of insect and vegetable pests; and the other engaged in the supervision of market and nursery gardens or other establishments concerned in the export of vegetable products, and in the issue of phytopathological certificates.

Particulars are given of the organization and functions of the various members of the staff and of the mode of administration to be employed in connexion with the various activities of the service.

KALLBRUNNER (H.). **Law for the protection of agriculture and forests against smoke injury in Austria.**—*Intern. Rev. Sci. & Pract. of Agric.*, N.S., ii, 1, pp. 224–230, 2 figs., 1924.

After a brief account of the damage inflicted by noxious gases and smoke from railways, industrial plants, factories, and the like, especially in the Styrian district of Austria, and of the legal difficulties in connexion with obtaining redress for the same, the author presents a summary of a Bill intended to regulate the matter by means of an Arbitration Court. Particulars are given of the lines on which it is proposed to conduct the operations of this Court; of the duties and qualifications of the industrial and agricultural experts equally represented thereon; and of the assessment of claims, payment of compensation, and the like.

Royal Decree (March 12, 1924) for the control of the enemies and diseases of forest trees [in Spain].—*Intern. Rev. Sci. & Pract. of Agric.*, N.S., ii, 2, pp. 476–477, 1924.

The above-mentioned Decree authorizes the 'Ministerio di Fomento' in conjunction with the 'Servicio de Estudio y Extinción de Plagas Forestales' [Department for the investigation and destruction of forest pests] to carry out the following measures in Spain: (*a*) the compilation of a list of forest parasites, their hosts, and habitat; (*b*) the application of prophylactic measures (including the regulation of imports from infected areas, and the like); (*c*) the indication of suitable control measures for any specific disease or pest; (*d*) the compulsory treatment by proprietors of diseases liable to spread beyond the confines of their property.

The 'Ayuntamientos' (Municipal Councils) shall be obliged to notify to the 'Dirección general de Agricultura y Montes' any pest or disease occurring in the forests under municipal jurisidiction, the work of control being undertaken, wherever necessary, by the 'Ministerio di Fomento'. The last-named body is also required to furnish pecuniary assistance towards the execution of adequate control measures; to popularize treatments of proved efficacy; and to issue special Royal Orders laying down the best methods of control of any disease which may appear.

Quarantine against Pear blight in Australia.—*Commonwealth of Australia Gazette*, No. 35, p. 1275, 1924.

By Quarantine Proclamation No. 125, published in the *Commonwealth of Australia Gazette* of 5th June 1924, the importation into Australia is prohibited of (*a*) all deciduous fruit trees or parts thereof (including the fruit and seeds); and (*b*) all plants or parts of plants of the family Rosaceae (including the fruit and seeds), which were grown in any country in which pear blight or fireblight (*Bacillus amylovorus*) exists; provided, however, that the Minister may permit the importation of ornamental plants or of new or special varieties of deciduous fruit trees or their fruit or seeds, subject to any conditions which he may think fit to impose.

Bunchy top control.—*Queensland Agric. Journ.*, xxi, 2, pp. 152–153, 1924.

A Proclamation dated 22nd December 1923 and rescinding that of 9th September 1921 prohibits the removal of any plant of the genus *Musa*, excepting only the fruit thereof, from any part of the areas adjacent to the New South Wales border on the south, and bounded on the north and west by the Logan and Albert rivers, to any place in Queensland beyond the boundaries of the said areas.

This Proclamation is intended to impede the spread of bunchy top of bananas [see this *Review*, iii, p. 527] which is stated to be so far practically restricted in Queensland to plantations either contiguous to, or in close touch with, those of New South Wales. Outside the main infected area the disease has been found only in a few isolated cases and is not spreading rapidly.

Mal dell' inchiostro del Castagno. [Ink disease of the Chestnut]. —*Riv. Patol. Veg.*, xiv, 1–2, p. 37, 1924.

By a Decree dated 2nd October 1923, the Minister of National Economy [Italy], in order to prevent the spread of ink disease of chestnuts [see this *Review*, iii, p. 245], has prohibited the use of chestnut leaves, husks, and mould as manure in nursery-gardens containing plants destined for sale beyond the confines of infected parishes. Proprietors are required to notify the sylvicultural authorities in the event of one or more trees dying from the disease. Where infection is limited, severely diseased or dead trees are to be felled, and the stumps and surrounding soil for a distance of two metres disinfected with 5 per cent. Bordeaux mixture plus 1·5 per cent. glue. Woods in which the disease is prevalent are to be transformed into coppices. The trunks of healthy trees felled in infected areas must be disinfected as above before removal from the forest.

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KINDSHOVEN (J.). **Erfolgreiche Bekämpfungsversuche gegen die Kropfkrankheit oder Hernie der Kohlgewächse.** [Successful experiments in the control of club-root or hernia of cruciferous crops.]—*Mitt. deutsch. Landw.-Gesellsch.*, li, 14, pp. 259–260, 1924.

In 1922 and 1923 the author secured excellent control of club-root of cabbage [*Plasmodiophora brassicae*] by the following methods. (1) Treatment of the seed-beds with peat mould mixed with ground lime (2 kg. of the former and 150 gm. of the latter per sq. m.); nitrate of lime, 50 gm. per sq. m. or 15 gm. per plant hole; or uspulun 120 gm. per sq. m., 2·5 gm. per hole, mixed with soil, or 2·5 gm. in ¼ l. water per hole. (2) Fertilization of the field with nitrate of lime, basic slag, and kainit 50 gm. per sq. m. (3) Immersion of the seedlings before planting in a solution of 2·5 gm. uspulun and 25 gm. solbar in 1 l. of water, mixed with clay and cow-dung. (4) A sparing use of night soil (excess of which resulted in heavy infection), destruction of refuse, and rotation of crops.

CAMPANILE (GIULIA). **Su di una nuova malattia dell' Aglio dovuta ad 'Helminthosporium allii' nov. sp.** [On a new Garlic disease due to *Helminthosporium allii* nov. sp.]—*Nuovi Ann. Min. Agric.*, iv, 1, pp. 87–106, 13 figs., 1924.

A new disease of garlic (*Allium sativum*) in the Fucino district, Italy, is described. It affects the so-called 'white' variety, but not the 'red' variety, which is more robust. The damage done is considerable, and large, well-developed bulbs growing in richly fertilized and irrigated soil are more often attacked than those below normal size.

The causal organism is *Helminthosporium allii* nov. sp., a Latin diagnosis of which is given. Diseased bulbs are usually covered with a black, powdery mass of hyphae and conidia, and on the back of the bulblets—often covering the whole surface—are characteristic, more or less depressed, oblong or roundish spots of

irregular outline and varying in diameter from a few to over 10 mm. At first these spots are dark brown, sometimes with a slight reddish-violet halo. A silvery sheen is developed in the centre of the spot from air bubbles, and later the spots become depressed, with a velvety and very black surface. In bulblets attacked at the top the nascent shoot is handicapped by having to make its way through diseased plant tissues. Diseased bulblets, which may be contiguous to healthy ones, do not rot, and the uninvaded portions retain their turgescence.

The microscopic characters and biology of the causal organism are described. The germ-tubes may enter by the stomata, or directly through the cuticle, or they may run along the surface for longer or shorter distances, uniting to form strands of hyphae. The mycelium advances either in the cuticle itself or immediately below it, or it may enter the epidermal or parenchyma cells. The yellowish-brown, geniculate conidiophores, measuring up to 90 μ in length, may be found singly or in tufts of 3 to 12. At each bend, as well as at the apex, light yellow to yellowish-brown, 3- to 10-septate conidia are borne, which vary greatly in shape, being straight or curved and cylindrical, elliptical, or fusiform. Not infrequently tri-radial conidia occur which recall those of *Trinacrium*, and it is thought that this phenomenon is due to one of the intermediate loculi emitting a germ-tube which, instead of continuing its growth, becomes thick-walled and septate. Attacked tissues collapse owing to the cell-walls being destroyed and the cell-contents absorbed by the fungus; in the empty spaces thus created abundant fructifications develop. The tissues surrounding a canker react by forming a corky layer. Isolated dark brown bodies which were found adhering to the inside of the bulb scales are thought to represent an attempt at forming sclerotia. They were viable and gave rise to a vigorous mycelium on being placed in suitable conditions.

Cultural and inoculation experiments [which are described] have proved the pathogenicity of *H. allii* and shown that it can also attack the aerial portions of the host plant.

KENDRICK (J. B.) & GARDNER (M. W.). **Soybean mosaic: seed transmission and effect on yield.**—*Journ. Agric. Res.*, xxvii, 2, pp. 91–98, 1924.

Up to the present soy-bean mosaic does not seem to be a serious disease in Indiana, although 25 varieties have been found affected, particularly the Midwest, Haberlandt, and Black Eyebrow. Rather extensive inoculation tests have failed to discover any host for soy-bean mosaic other than the soy-bean itself.

That the disease is capable of being transmitted by a varying and usually rather low percentage of the seed is confirmed. Fifteen varieties were planted in parallel plots on 26th May 1921, and the occurrence of 0 to 5 per cent. of mosaic seedlings was noted on 26th June. Seed of the Midwest variety from an infected field gave 4 per cent. mosaic among its seedlings, whilst seed from mosaic Midwest plants gave 9 per cent. in 1921 and 17 per cent. in 1922. In the latter year in another plot planted with seed from healthy plants none were affected.

Varieties differ somewhat in their ability to transmit mosaic, and individual plants of the same variety also differ greatly (from 0 to 33 per cent.) in the extent to which the disease is transmitted to the progeny. No particular relation was found between the percentage of infection and the location of the seed on the parent plant or the date of the infection of the latter.

In 1921 and 1922 a conspicuous brown mottling of the seed coat occurred, but investigation showed that the symptom was not attributable to mosaic.

The efficiency of selecting seed from healthy plants as a control measure was tested by sowing such seed in 1922, with the result that no infected seedlings occurred. Selections made, however, from apparently healthy plants in 1922, when, owing to the drought, the symptoms were not easily recognizable, contained 3 mosaic selections out of 42.

The secondary spread of mosaic is more extensive in some seasons than in others and, so far, the agent of dissemination has not been determined.

The relative germination of seed from mosaic and healthy plants was tested, and the results indicate that mosaic has little if any influence on the germinating power. Details are given regarding the effect of mosaic on the yield of seed; the loss was found to vary from 30 to 75 per cent. The number of seeds per plant was greatly reduced, and, in plants with mosaic of seed origin, frequently no seeds at all were borne.

LEHMAN (S. G.) & WOLF (F. A.). **A new downy mildew on Soybeans.**—*Journ. Elisha Mitchell Sci. Soc.*, xxxix, 3–4, pp. 164–169, 2 pl., 1924.

Soy-beans (*Soja max*) [*Glycine soja*] in various localities of North Carolina have been attacked by an apparently unreported species of downy mildew, which produces irregular chlorotic areas on the leaves. On the lower leaf surface many of these areas are covered with a greyish layer of conidiophores, and minute brown specks appear in the diseased areas, later enlarging, fusing, and attaining a diameter of 5 to 10 mm. The spots become surrounded by a conspicuous dark brown border, $\frac{1}{4}$ to $\frac{1}{2}$ mm. in width, and often separated from the normal tissues by a narrow, irregular, chlorotic zone.

The mycelium is intercellular, and the slender hyphae send long, tenuous haustoria into the cells, the chloroplasts of which eventually disappear. The conidiophores are 300 to 500 μ in length and five to eight times dichotomously branched. The ultimate branchlets are pointed, recurved, unequal, and form right to obtuse angles.

The conidia are hyaline, ovoid to subglobose, 24 by 20·5 μ, and fugaceous. They germinated in water, at room temperature in September, by the formation of a slender, hyaline, lateral germ-tube, the power of germination being lost in a day or two.

Light brown, globose oospores, 18 to 23 μ, and with a smooth wall 1 μ in thickness, are fairly numerous in diseased tissues. Oogonia in different stages of maturity may also be observed, but the presence of antheridia could not be demonstrated, presumably owing to the lateness of the season. The old oogonial wall may

collapse after the oospores become mature and persist for some time as a layer 6 to 7 μ thick.

The type of the conidiophores and the manner of germination of the conidia of the soy-bean downy mildew are characteristic of the genus *Peronospora*. A comparison of the causal organism with *P. viciae*, *P. trifoliorum*, and *P. ononidis* revealed sufficient differences in morphological characters to justify the establishment of a new species, to which the name *P. sojae* is given.

Arrhenius (O.). **Försök till bekämpande av Betrotbrand. II. Kalkningens och markreaktionens inflytande på sjuka och friska betors utveckling.** [Experiments in the control of Beetroot rot. II. The influence of lime applications and soil reaction on the development of diseased and healthy Beets.]—*Kungl. Landtbr. Akad. Handl. och Tidskr.*, lxiii, 3, pp. 256–266, 1 col. pl., 1924.

In continuation of his previous investigations on the control of root rot of sugar beets [see this *Review*, iii, p. 74], the author again tested the soil reaction of a number of fields, the results clearly indicating that acidity was more favourable than alkalinity to the development of the disease. The diseased soils showed an average P_H value of 6·0 as compared with 6·5 in healthy fields. In order to eliminate such factors as climatic conditions and drainage, samples of the most severely diseased soils were procured, and half of each lot was treated with sufficient lime to bring the soil reaction to P_H 7·2 to 7·4, while the other half was left untreated, and beet seedlings were sown in all. The treated soils gave much better yields than the untreated, the incidence of infection being reduced in one case from 100 to 15 per cent. Combined fertilizer tests on the lines previously described [*loc. cit.*] fully confirmed the earlier results.

Pot experiments, in which the P_H was adjusted by means of sulphuric acid or soda, to determine the influence of the soil reaction on the development of healthy plants, showed that the maximum yields were obtained at P_H 7·3 to 7·5. There was a second maximum at P_H 8·5 to 8·9, which was, however, accompanied by attacks of heart rot, which is in some respects analogous to the grey speck of oats [see this *Review*, iii, p. 24]. Such highly alkaline soils, however, are not found in Sweden under natural conditions, and this second maximum is therefore of purely theoretical interest. Similar results were also obtained using lime or gypsum, a reaction of P_H 7·5 producing symptoms of heart rot.

The results of a supplementary experiment on a larger scale showed that the effects of liming are more pronounced on acid than on neutral soils. Excessive applications of lime, gypsum, or soda, however, were found to cause a reduction in the yield, the first-named also promoting heart rot.

Millard (W. A.). **Crown rot of Rhubarb.**—*Univ. Leeds and Yorkshire Council for Agric. Educ. Bull.* 134, 28 pp., 2 col. pl., 4 figs., 1924.

Crown rot of rhubarb, which causes severe damage in Yorkshire, is characterized by a soft brown rot near the crown of the root;

swollen bases of the stalks and sheathing leaves, which show a brown discoloration at their junction with the crown; puce-coloured foliage leaves; the absence of a terminal bud; and the production of spindly rhubarb sticks from the lateral buds. Infection may occur at soil level near the crown, or it may ascend from the lateral roots. Eventually the plant tissues below the crown rot, and the head breaks away. Both forced and unforced roots appear equally susceptible to the disease, which, though it may be contracted the first year after planting in infected soil, does not usually show itself until the second.

Crown rot is caused by an organism which was first isolated from diseased material in 1915 and again, after the loss of the original cultures, in 1919, and to which the name *Bacterium rhaponticum* n. sp. has been given. It is a non-motile, non-sporing, Gram-negative bacterium, 1·75 to 2·28 by 0·4 μ in diameter, forming (on nutrient rhubarb agar at +10 Fuller's scale) round, flesh-coloured, translucent, refractive colonies with entire margins, later becoming large, lobed or auriculate, slightly yellow, and opaque. It grows well on media from 0 to +20 and 0 to −60 (Fuller's scale), but feebly at +25 and beyond. A list of the sugar reactions is given. The organism may be placed in the genus *Lankoides* of the tribe Ebertheae (Castellani and Chalmers, 1918), or in sub-group IV of the *Bacillus coli* group (MacConkey, 1905), or in the genus *Phytomonas* of the tribe Erwiniae of the Society of American Bacteriologists [see this *Review*, iii, p. 18].

The disease is disseminated in the soil by the distribution of the dry, rotten tissues exposed after the collapse of the crown of a badly infected plant; by the use of old roots for sets and indiscriminately ploughing in the refuse; and by strewing the ground round the forcing shed with diseased roots.

Infected plants cannot be saved, and remedial measures should therefore be concentrated on eradicating the disease from the soil. The results of experiments in the control of the disease showed that a solution of ammonia (3·5 per cent. by volume, 2 galls. per sq. yd.) was very effective for this purpose. Its price, however, worked out at about £60 per acre, a prohibitive figure for practical purposes, and further experiments are necessary to ascertain whether a weaker solution or the use of carbonate of ammonia would do equally well. The substitution of green manure for the large quantities of organic matter applied at present is recommended, and it is also believed that some strains of the Victoria variety are more resistant than others.

Maladies de l'Artichaut. [Diseases of the Artichoke.]—*La Vie agric. et rurale*, xxiv, 24, p. 392, 1924.

In the province of Oran, Algeria, where artichokes [*Cynara scolymus*] are stated to cover a thousand hectares, a serious disease due to a species of *Oidium* was observed in 1923. The development of the plants was arrested from December onwards, the leaves turning yellow and the heads hardening before maturity. The reduction in the yield appears to be considerable, the anticipated harvest being only 35,000 heads per hect. as compared with 150,000 in normal years.

SHEAR (C. L.). **Grape rust in Florida.**—*Phytopath.*, xiv, 3, pp. 170-171, 1924.

A serious disease of grape vines caused by the rust *Physopella vitis* Arthur (*Phakospora vitis* (Thüm.) Syd.), brief notes on the synonymy of which are given, was found in abundance at Orlando, Florida, in November 1923. Most of the vines were completely defoliated and had produced only short shoots with short nodes, which would certainly not yield a profitable crop in the next season. The Fern, Blondin, Wonder, and Carmen varieties were apparently resistant (especially the last named). There is stated to be little hope of successful control by spraying.

GARD (M.). **L'apoplexie de la Vigne.** [Apoplexy of the Vine.]—*La Vie agric. et rurale*, xxiv, 22, pp. 343-344, 1924.

Several methods for the control of apoplexy of the vine [*Fomes igniarius* or *Stereum hirsutum*: see this *Review*, iii, p. 314] are briefly described.

Treatment with arsenite of soda (30 kg. carbonate of soda and 30 kg. arsenious acid in 100 l. of water) has been found extremely efficacious, but many vine-growers hesitate to employ this method owing to the highly toxic nature of the mixture. The results of the author's recent experiments have shown that this treatment (which is stated to be entirely without risk if proper precautions are taken) may safely be applied right up to, and even after, the opening of the buds. Biennial or possibly even triennial applications should suffice for the control of the disease.

Other methods of combating apoplexy are the excision of the decayed wood or 'tinder' (as practised in Asia Minor); pruning the stock immediately after the withering of the scion; regrafting below the decayed wood; or splitting the affected branches to admit air.

During the past year the disease has presented certain remarkable features. On the whole it was less prevalent than in 1922, but in the calcareous soils round Cognac the incidence of infection amounted to 25 per cent. The progress of the disease was much more gradual than usual, a state of partial desiccation continuing for 8 to 10 days or longer before leading to the well-known phenomena of dry tendrils, red leaves, and premature defoliation. The tips of the branches and the most recently developed leaves were almost uniformly the first parts to decay. The chlorotic tinge along the veins of affected leaves turned to a reddish colour which was more pronounced in black than in white varieties. Complete desiccation and defoliation ensued, and the tips of the branches became brown and brittle. In some cases the decay was arrested midway down the branch, the base of which remained green and eventually matured, at times retaining leaves which were only slightly or not at all affected. In certain cases the affected branches were irregularly distributed over the vine, while the others remained completely healthy.

The disease, while attaining its maximum severity, as usual, in July and August, was observed as early as May and June and lasted into the autumn.

Hengl (F.). **Vergleichende Versuche des Jahres 1923 gegen verschiedene Rebenschädlinge.** [Comparative experiments of the year 1923 in the control of various Vine pests.]—*Allg. Weinzeit.*, xli, 4, pp. 51–52, and 5, pp. 72–76, 1924.

The results are described of experiments in the control of various diseases and pests of the vine, carried out by the Vienna Plant Protection Institute in co-operation with the Austrian Vine-growers' Association.

Excellent results in the control of 'roter Brenner' (*Pseudopeziza tracheiphila*) were obtained by a preventive application on 14th May, followed by the ordinary schedule for downy mildew [see below] of Bordeaux mixture 2 per cent.; Bosna paste 2 per cent.; Bosna powder 'A', unfilled, 0·6 per cent.; the same, filled, 1 per cent.; or Bosna powder 'B' 0·6 per cent., the two first-named being the most reliable. Nosperal and kurtakol proved less satisfactory. The untreated controls were heavily infected. Early treatment is stated to be very important, applications given a week later than the above having failed to ensure control.

The treatment for the control of downy mildew (*Peronospora* [*Plasmopara*] *viticola*) was applied on 28th May, 7th and 28th June, 12th and 27th July, and 17th October. Only Bosna paste 2 per cent. and perosan (formerly known as cuprol) 2 per cent. proved fully equal to Bordeaux mixture 2 per cent. Next in efficacy were the Bosna powders mentioned above. Nosperal 1 and 1·5 per cent. was not satisfactory, and kurtakol, which gave good results in the previous year's tests [see this *Review*, ii, p. 533], was not effectual at concentrations below 1 per cent. Ciprin 0·35 per cent. and Cusisa powder absolutely failed to control the disease.

Powdery mildew (*Oidium tuckeri*) [*Uncinula necator*] was admirably controlled by the Ventilato-Trezza Semplice sulphur mixture (85° to 90°), supplied by the firm of Montecatini. Oidal (Gold- und Silberscheideanstalt, Frankfurt-a.-M.) possesses good adhesive qualities but its effects are somewhat less powerful and rapid than those of Ventilato sulphur. The three colloidal sulphurs, sulfarol (Firma Chinoin-Ujpest), sulikoll (Oderberg chemische Fabrik), and cosan [de Häen] gave very good results when applied in 0·25 to 0·5 per cent. concentrations, during the second half of May, though control was effected even when the treatments took place after flowering. Dormant applications and lower concentrations were not reliable. Owing to the difficulty of ensuring the necessary water-supply in the vine-growing districts, the use of these colloidal preparations cannot, in spite of their undoubted efficacy, be generally recommended. Two liquid lime-sulphur mixtures, two substitutes in powder form, and solbar, reduced the incidence of the disease but failed to control it entirely.

Swartwout (H. G.). **Grape growing in Missouri.**—*Missouri Agric. Exper. Stat. Bull.* 208, 35 pp., 19 figs., 1924.

In the section dealing with insect pests and fungous diseases (pp. 25–35), the symptoms of black rot [*Guignardia bidwellii*], downy mildew [*Plasmopara viticola*], and anthracnose [*Gloeosporium ampelophagum*] are briefly described. The first-named is stated to

cause more damage in Missouri than all other pests and diseases combined.

The following spraying schedule is recommended. (1) Dormant: lime-sulphur 1 in 8 against scale and anthracnose, or Bordeaux mixture 8–8–50 for the latter only. (2) Bordeaux 4–4–50 for black rot and anthracnose, to be applied when most of the shoots show the second or third leaf. (3) The same as (2), to be given just before the blossoms open: this spray also controls downy mildew. (4) The same as (3), to be applied as the petals fall or as soon as the fruit has set. (5) The same as (4), to be given 10 to 14 days later. (6) The same as (5), to be applied a fortnight later (about 1st July). (7) The same as (6), to be given a fortnight later (generally necessary only in the south).

One or two additional treatments may be advisable in damp seasons or with susceptible varieties. These should be given at intervals of ten days or a fortnight and should consist of a non-staining spray, e. g. ammoniacal copper carbonate.

Ravaz (L.). **Chronique: Traitement de la chlorose.** [Notes: treatment of chlorosis.]—*Prog. Agric. et Vitic.*, lxxxi, 16, pp. 368–369, 1924.

The best method for treating chlorosis of the vine when the season is too far advanced to allow of swabbing is to apply iron sulphate solution round the collar of the affected plants. The best solution to use is 250 to 500 gm. of iron sulphate to 10 litres of water.

If the transport of water is difficult, the chemical may be applied in powder form, but in this case it must be done when rain is expected immediately, as otherwise it becomes insoluble and useless.

Marchal (P.). **Recherches effectuées dans les stations de pathologie végétale en 1923.** [Researches conducted at the phytopathological stations in 1923.]—*Ann. Sci. Agron.*, xli, 3, pp. 179–194, 1924.

Most of the items of interest in this survey, based on data furnished by Foëx, Ducomet, Chabrolin, and others, of the researches conducted in French phytopathological stations during 1923, have already been noticed in this *Review* from different sources.

Department of Plant Pathology and Botany.—*Thirty-Sixth Ann. Rept. Maryland Agric. Exper. Stat. for 1922–23*, pp. xv–xvii, 1924.

A field study of *Septoria* disease of tomatoes [*S. lycopersici*] showed the importance of crop rotation as a means of control. Other causes were found to be responsible for much of the leaf spot usually attributed to this fungus.

Various points in the life-history of the peach rot *Sclerotinia* [*S. cinerea*] have been studied. Methods were devised for distinguishing the strains of the fungus, and its relations to acidity were determined, thereby facilitating control by soil treatment [see this *Review*, iii, p. 141]. The annual losses from this disease are estimated at 20 to 50 per cent. of the crop.

The results of dusting and spraying experiments in the control

of apple, cantaloupe, tomato, and potato diseases indicate the great value of the former method.

The selection, by examination of the cob colours, of maize ears free from root rot has resulted in an average addition to the yield of 10 bushels per acre on a number of test plots.

A recent survey of the damage to tomatoes by mosaic disease has shown losses on early infected plants up to 50 per cent., the total field loss in severe cases amounting to 20 per cent. The average loss over the whole crop of the State, however, is estimated as not exceeding 2 to 4 per cent. Similar figures represent the situation as regards tobacco mosaic. Practical methods of control include care in selection and management of beds, in handling seedlings in transplanting, and in the methods of cultivation.

Negative results have been obtained in tests of the transmission of tomato mosaic and other diseases by the seed.

MANNS (T. F.) & ADAMS (J. F.). **Department of Plant Pathology and Soil Bacteriology.**—*Ann. Rept. Delaware Agric. Exper. Stat. for the fiscal year ending June 30, 1923*, pp. 25–48, 1924.

Cytological studies on the pox (soil rot) disease of sweet potatoes revealed in the lesions the presence of an actinomycete, staining with carbol fuchsin. This disease was formerly attributed to *Cystospora batata*, but its association with *Actinomyces* was referred to by Taubenhaus (*Journ. Agric. Res.*, xiii, p. 437, 1918). In a series of inoculation experiments on clean sweet potato sprouts, carried out with pox scabs, *Actinomyces scabies*, bacteria from pox lesions, a culture of the *Actinomyces* from diseased sweet potatoes, and a mixture of bacteria and the *Actinomyces*, respectively, positive results were obtained in the case of the inoculations with the pox scabs and the cultures containing the *Actinomyces* from sweet potato, the others remaining healthy. Lime and manure, separately or together, increased the amount of disease where present.

A study of the type of sweet potato soil rot or pox infection prevalent in 1922 as compared with 1921 showed that this disease is generally associated with mature, fleshy roots. In 1922 drought conditions, coinciding with the establishment of the disease, occurred during the development of the fleshy roots, whereas in 1921 similar conditions prevailed during the initial stages of growth. A correlation was observed between the application of nitrogen and the incidence of soil rot.

Sweet potatoes of the Big Stem, Yellow Jersey, and Gold Skin varieties were grown in soil to which inoculated sulphur at the rate of 200, 300, or 400 lb. per acre was applied for the control of pox and soil stain or scurf (*Monilochaetes infuscans*). The best results were obtained with 400 lb. sulphur applied broadcast and drilled, soil stain being reduced from 15 per cent. to a trace and pox from 95 to 40 per cent.

In another test inoculated sulphur at the rate of 485 lb. per acre was applied to a field planted with ordinary potatoes showing a trace of scab [*Actinomyces scabies*]. The harvested tubers showed no sign of disease, but the increased acidity of the soil produced

by the treatment resulted in a marked retardation of growth. This treatment evidently requires great caution in the determination of the optimum quantity of sulphur which can be used with safety. A crop of rye planted in the treated plot in the following spring failed to come up as a result of the cumulative effect of the acidity.

Studies on one-year-old wood of peach trees affected by yellows [see this Review, i, p. 298] showed no material difference between the carbohydrate synthesis of diseased and healthy wood. The conspicuous difference lies in the retardation, in affected trees, of the utilization of the carbohydrate products. In two-year-old wood a more pronounced and permanent deposition of gum was observed in the medullary rays of diseased trees. Functional derangements in the metabolic processes of the leaves and an abnormally early development of the flower buds were also found to be associated with yellows. A consistent hypoplasia of the various tissues of affected trees was observed, the cortex being noticeably shallow, the bast fibres shorter, and the xylem ducts smaller than in normal wood.

The most important disease of cantaloupes during the period under review was downy mildew (*Pseudoperonospora cubensis*), which caused a loss of at least 40 per cent. The examination of material in different stages of the disease showed that sporulation begins in the intermediate stage, the sporophores apparently arising from one or two strands of hyphae under the guard cells on the lower surface of the leaf. The serious effects produced on the host, which seem out of all proportion to the small amount of mycelium, are believed to result from the formation of a toxic substance, probably an enzyme. The results of experimental work in the control of the disease by dusting with copper arsenate or copper lime arsenate indicated that heavy applications were no more efficacious than a light, even distribution. Complete control is apparently impossible under weather conditions favouring the disease.

A root rot of canning peas, which did not show the usual darkened necrotic symptoms, was found to be associated with a species of *Fusarium*. Another disease of peas affected only the lower leaves, which exhibited dark brown, necrotic areas about $\frac{1}{4}$ inch in diameter. The general appearance of diseased individuals was suggestive of leaf blight (*Ascochyta pisi*). The fruiting bodies, however, were not prominent and the spores were unicellular.

A mosaic disease of soy-beans, involving mottling and atrophy of the leaves, has appeared in various parts of the State.

ADAMS (J. F.). **Plant diseases and their prevalence for 1923 in Delaware.**—*Delaware Agric. Exper. Stat. Extension Circ.* 14, 29 pp., 1924.

Among the more important records of phytopathological interest contained in this Report may be mentioned the following. A very severe outbreak of apple scab (*Venturia inaequalis*) occurred in Sussex County as a result of the early and heavy ascospore discharge which started on 28th March. Fireblight (*Bacillus amylo-*

vorus) was more generally severe than for three years past. Sooty blotch [*Phyllachora pomigena*] and fly speck (*Leptothyrium pomi*) developed extensively as a result of a few days' rain at the end of August. Bitter rot (*Glomerella cingulata*) was extremely severe, especially on King David apples. Copper fungicides only were effective in control.

Black rot of grapes (*Guignardia bidwellii*), the most important vine disease in Delaware, was successfully held in check by early applications of copper fungicides. The value of dusting proved equal to that of spraying.

Leaf curl (*Exoascus deformans*), brown rot (*Sclerotinia cinerea*), and scab (*Cladosporium carpophilum*) of peaches were more prevalent than usual, and a severe outbreak of little peach [see this *Review*, i, p. 298] was observed. The most serious disease of peaches, however, was bacterial shot hole (*Bacterium pruni*). In two cases infected leaf petioles showed fruit bodies of *Phoma persicae*, reported to cause a die-back of peaches.

Lima beans [*Phaseolus lunatus*] were severely attacked by downy mildew (*Phytophthora phaseoli*) which caused up to 50 per cent. of pod infection on late crops. Mosaic and pod and leaf blight (*Diaporthe phaseolorum*) were also more prevalent than usual on this host.

Yellows or wilt (also known as split stem) of sweet potato (*Fusarium hyperoxysporum*) showed a considerable increase in prevalence, the incidence in some fields amounting to 60 per cent.

Leaf spot of tomatoes (*Septoria lycopersici*) reduced the crop by at least one-quarter. Mosaic was a limiting factor in tomato seedbed production.

Excellent results in the control of covered and loose smut of barley (*Ustilago hordei* and *U. nuda*) were obtained by seed disinfection with semesan, the incidence of *U. hordei* being reduced in one case from 22 to 0·5 per cent. by the treatment. The same preparation gave good control of leaf blotch and stripe of barley (*Helminthosporium sativum* and *H. gramineum*), reducing infection from 20 to 1 per cent. in the former case and from 5 per cent. to nil in the latter.

Jahresbericht der preussischen landwirtschaftlichen Versuchs- und Forschungsanstalten in Landsberg a. W. Jahrgänge 1920–21, 1921–22, und 1922–23. [Annual Report of the Prussian Agricultural Experimental and Research Institute at Landsberg a. W. for the years 1920–21, 1921–22, and 1922–23.] —*Landw. Jahrb.*, lx, 3, pp. 355–416, 1924.

The following references of phytopathological interest, other than those already noticed, are included in this Report of the former Kaiser Wilhelm Institute, which was transferred from Bromberg (Posen) to Landsberg-an-der-Warthe (Brandenburg) on the cession to Poland in 1920 of most of the former province.

The seedling diseases of cereals, especially the soil acidity disease [see this *Review*, ii, p. 499], received considerable attention in 1920–21. The incidence of the disease is particularly severe on sandy soil, but it may be controlled by thorough cultivation, the

timely application of liberal top dressings of lime, the substitution of nitrate of soda for sulphate of ammonia, and the plentiful use of stable and green manure.

In 1921 and 1922 a number of seed disinfection tests were made for the control of various cereal diseases. In the former year the following preparations were tested against loose smut of oats [*Ustilago avenae*]: copper sulphate (Kühn's method), formaldehyde, sublimoform, corrosive sublimate with sodium chloride, weizenfusariol, uspulun, fusafine, potassium sulphide, germisan, 2138, 2139, and resinol-parol. Two varieties of oats were used, on one of which most of the treatments had little effect as regards germination and vigour; corrosive sublimate, however, greatly impaired these qualities in both varieties. The second variety was stimulated by most of the treatments. Smut was completely absent in nearly all the treated plots, but a very small amount occurred in those treated with copper sulphate, formaldehyde, uspulun 0·25 per cent., 2139, and one or two others. The grain yield was slightly reduced by most of the treatments; sublimoform caused a considerable decrease (14 per cent.) as compared with the controls, while formaldehyde gave a slight increase (4 per cent.).

The experiments were continued in 1922 with twelve preparations. Formaldehyde 0·2 per cent. slightly reduced both germination and vigour, the remaining fungicides affecting the latter quality only. The incidence of smut in the untreated plots was 22·65 per cent. and, in those from seed immersed in water for 30 minutes and 1 hour, 21·6 and 21·1 per cent. respectively. There was a considerable amount of infection in the plots from seed immersed in 0·25 and 0·5 per cent. uspulun (11·1 and 9·4 per cent.) and sprinkled with 2 per cent. segetan (12·8 per cent.). Immersion in 1 per cent. segetan and most of the other treatments completely eliminated all trace of infection; that occurring in the plots from seed treated with 793, 1111, and germisan (sprinkling) was negligible. Formaldehyde 0·2 per cent. and sublimoform 0·3 per cent. reduced the yield of grain by 15 and 18 per cent. respectively, while most of the other preparations slightly increased it. Corrosive sublimate with sodium chloride produced the best yields both of grain and straw; the latter was decreased by most of the preparations.

Against covered smut of barley [*Ustilago hordei*] nine fungicides were tried in 1921. Infection in the controls amounted only to 2 to 3·5 per cent. and smut was completely absent in all the treated plots, except where the seed was treated with copper carbonate, formaldehyde 1 per cent. for 15 minutes, or 1111 0·25 per cent. for 30 minutes. Formaldehyde 0.2 per cent. slightly impaired germination and vigour and considerably reduced the yield of grain (by about 37 per cent.). Certain other preparations greatly increased the yield, notably 1103 (about 31 per cent. increase) and weizenfusariol (0·466 per cent.), immersion and sprinkling, (about 31 and 30 per cent. increase respectively).

Eight preparations were tested for the control of stripe disease of barley (*Helminthosporium* [*gramineum*]), all of which slightly increased vigour without impairing germination. Infection in the treated plots ranged from 5·3 to 10 per cent. compared with 32·5

per cent. in the untreated controls. Uspulun 0·5 per cent. (2 hours' immersion) gave the best control and also increased the yield by 35 per cent. Sprinkling with germisan 0·5 per cent. for 45 minutes resulted in an increase of 45 per cent. in the yield, which was improved to some extent by all the preparations tested.

For the control of bunt of wheat [*Tilletia tritici* and *T. levis*] ten fungicides were tried. Formaldehyde 0·2 per cent. reduced germination and vigour by about 40 and 30 per cent. respectively. There was no infection of any of the treated plots except where Bordeaux mixture was used, giving 0·5 per cent. bunt. The incidence of the disease on the untreated plots only amounted to 4·3 per cent.

The results of experiments in the control of *Rhizoctonia* [*solani*] by potato tuber disinfection showed that immersion in corrosive sublimate 0·1 per cent., formaldehyde 0·2 per cent., sublimoform 0·35 per cent., segetan III and IV 1 per cent., segetan IIIa 0·5 per cent., tillantin C 0·5 per cent., 778 1 per cent., and kalimat 0·5 per cent. destroyed the sclerotia in five minutes. Immersion in uspulun, germisan, or fungolit [Hohenheimer Beize] 0·5 per cent. had the same effect in ten minutes, fungolit 0·25 per cent. in twenty minutes, and uspulun 0·25 per cent. or 778 0·75 per cent. in half an hour.

The influence of soil constitution, irrigation, fertilization, and time of sowing on the incidence of root rot of beet was investigated. Seed sown on 25th April, 12th June, and 28th July showed 45, 22, and 16 per cent. of infection respectively; in sand with a plentiful admixture of humus there was 28 per cent. of decay, in good beet soil 39, in yellow clay 41, and in sand 55 per cent. Applications of lime and methods of irrigation had little or no effect on the incidence of the disease, in which the causal organisms were represented as follows: *Pythium de Baryanum* 60 to 65 per cent., *Phoma betae* 30 to 33 per cent., and *Aphanomyces levis* 3 to 5 per cent. *Cercospora beticola* affected chiefly different strains of the Klein-Wanzlebener sugar beet. The Schladener yellow Eckendorfer, Friedrichswerther Zuckerwalze, Lawätz yellow Barres, Knoche's, and Dieckmann varieties were quite immune, and Criewener Eckendorfer, Mette's improved Eckendorfer Riesenwalze, Kirsche's Ideal, Moringia, and Walter's Eckendorfer very highly resistant.

Stoa (T. E.). **The early harvest of rusted Marquis Wheat. (A preliminary report.)**—*Journ. Amer. Soc. Agron.*, xvi, 1, pp. 41–47, 1924.

The results of experiments conducted in 1922 on Marquis wheat at Fargo, North Dakota, indicated that, notwithstanding the interference by stem rust [*Puccinia graminis*] with the normal processes of maturation, the plant continues to transport into the grain the materials necessary to constitute a desirable kernel. Premature harvesting of rusted wheat, popularly regarded as advisable or even essential, was found to curtail this transportation, thereby reducing the possible yield and diminishing the grade and quality produced. The proper stage for the harvesting of rusted wheat would appear to be the same as for that of a normal crop, namely, when the grain is

sufficiently firm to necessitate a certain amount of pressure by the thumb-nail to make a dent in the kernel.

JOHNSTON (C. O.) & BOWER (C. W.). **A method of detecting mixtures in Kanred Wheat seed.**—*Journ. Amer. Soc. Agron.*, xvi, 7, pp. 467–470, 1924.

An accurate method of detecting mixtures in threshed grain has long been required by the Crop Improvement and Seed Testing Associations, and tests were carried out during 1922–23 to ascertain whether differential reaction to stem rust (*Puccinia graminis tritici*) could be used for this purpose.

Two-weeks-old seedlings from a number of growers' samples were inoculated by shaking a bunch of heavily rusted seedlings over the leaves previously moistened by an atomizer. The resultant crop showed 0 to 50 per cent. infection. Control plants of pure Kanred seed were absolutely free from rust, while the susceptible Improved Turkey showed 100 per cent. infection. It was noted that the individual plants from the mixed samples were either heavily rusted or entirely healthy.

This method may equally well be applied to the Kota, Marquis, and other hard varieties, while a corresponding test with leaf rust [*P. triticina*] serves a similar purpose for the Fulcaster, Mediterranean, and other soft wheats.

FISCHER (G. J.). **Steinbrandbekämpfung in Uruguay.**—[Bunt control in Uruguay.]—*Angew. Bot.*, vi, 2, pp. 125–140, 1 diag., 1924.

In continuation of the experiments conducted with uspulun in 1921–22, a further series of tests was instituted to ascertain the effect of this and other preparations on wheat in the field.

The seed was treated as follows: (*a*) control; (*b*) thorough washing in water for five minutes; (*c*) formalin (37 per cent. formaldehyde) 2·5 per 1,000, immersion for five minutes; (*d*) copper sulphate 10 per 1,000, immersion for five minutes; (*e*) ditto, followed by five minutes' immersion in milk of lime; (*f*) uspulun (12 concentrations ranging from 1 to 5 per 1,000), immersion for from five minutes to one hour; (*g*) thorough rinsing followed by one hour's soaking in water.

The results of the tests [details of which are given] showed that germination was retarded by (*c*), (*d*), and, to a slighter extent, by (*e*). Formalin destroyed about one-third of the germinable seeds, and copper sulphate also caused considerable damage which was, however, diminished where milk of lime was subsequently used. The latter treatment also modified a certain weakness characteristic of the plants grown from seed immersed in copper sulphate. Uspulun produced no adverse effect on germination. Bunt [*Tilletia tritici* and *T. levis*] was completely eliminated by copper sulphate and uspulun 5 per 1,000 for five minutes and upwards and reduced to a minimum by the other treatments except uspulun 1 per 1,000 for five minutes. Rinsing with water was ineffectual, and pre-soaking actually increased the incidence of infection. None of the treatments controlled loose smut [*Ustilago tritici*]. The application of uspulun at all concentrations resulted in a very con-

siderable increase in the yield of grain and the same was obtained with copper sulphate followed by milk of lime. The results of tests showed that uspulun to replace that consumed must be added when the same mixture is used for the second time.

SHELTON (J. P.). **Breeding Wheats resistant to flag smut.**—*Agric. Gaz. New South Wales*, xxxv, 5, pp. 336–338, 1924.

This paper records the steps taken by the author to breed varieties of wheat resistant to flag smut (*Urocystis tritici*), since none of those grown in New South Wales at present is resistant. Certain American resistant varieties, chiefly winter wheats, were tested at the Bathurst Experiment Farm, the intention being to use the material in breeding work in order to obtain varieties more suitable for Australian conditions. In the trials [which are described] a very susceptible local variety, Cleveland, was used as a standard for comparison and only the results of the early-sown plots were taken into account, as experience has shown that late sowing tends to minimize the disease.

The results of the first two seasons indicate that, while some of the American wheats tried are apparently more resistant to flag smut than the local varieties, only one, the spring wheat Galgalos, which remained immune throughout the trials, was of sufficient merit to warrant it being used as a resistant parent in breeding work. Trials with hybrids from Galgalos, and with additional resistant varieties from the United States, are proceeding.

CARNE (W. M.). **Flag smut of Wheat (Urocystis tritici.)**—*Journ. Dept. Agric. Western Australia*, i, 2nd ser., 2, pp. 142–147, 3 figs., 1924.

Western Australia is believed to have been only recently invaded by flag smut of wheat (*Urocystis tritici*), which was first noticed in 1921, and the disease has up to now appeared in a mild form, its occurrence having been recorded from several localities in the centre of the wheat belt. The damage has been estimated at less than one bushel per acre, but the author points out that even an average loss of half a bushel per acre, if generalized, would mean a total to the State of 800,000 bushels on the figures for 1923. Great stress is, therefore, laid on the importance of checking the disease in the early stages, directions for which are given. The varieties of wheat affected are stated to be Gluyas Early, Merredin, Florence, Nungarin, Newman's Early, and Belka, but the data collected are too incomplete to allow of any conclusions being reached in regard to the susceptibility of the locally grown varieties.

WENIGER (WANDA). **Ergot and its control.**—*North Dakota Agric. Exper. Stat. Bull.* 176, 23 pp., 7 figs., 5 diag., 1924.

A description is given of the symptoms of ergot (*Claviceps purpurea*) of rye, wheat, and other Gramineae, together with the life-history of the fungus and an account, based on the work of Stäger, of its biological specialization. A list of 35 grasses liable to infection in North Dakota is given.

Under local conditions moisture appears to be a very important

factor in the development of the disease, and meteorological data show that the absence of humidity during the first ten days to three weeks of June (i. e., the period immediately preceding the flowering of the host) greatly reduces the amount of infection.

Rotation of crops is essential to the control of the disease, and the succession of rye to durum wheat or vice versa must be strictly avoided. Amber durums are more susceptible than common wheat or red durums. The Marquis, Red Bobs, Red Fife, Ruby, Bluestem, Preston, and Kota varieties of wheat, especially the three last named. are comparatively resistant. Hannchen barley and other varieties with widely open glumes are susceptible. Late-maturing varieties of rye keep their glumes open longer and are always observed to be more heavily infected than the early sorts. There is also a relation between stooling and ergot infection. Little stooling means short blossoming with fewer chances of infection by the spores of the fungus. There appears to be little chance of developing genuinely resistant varieties of rye by breeding, but for practical purposes those with closed glumes are equally efficient. All varieties of winter, spring, and self-sown rye are liable to be heavily attacked. Oats are very seldom attacked and then only an occasional head. Brome grass (*Bromus inermis*) and *Agropyron* are exceedingly susceptible; 60 to 70 sclerotia may occur on a single panicle of the former and up to 40 on the latter.

Directions are given for the control of the disease by suitable methods of crop sanitation and treatment of the seed by the common salt and formaldehyde process [see this *Review*, ii, p. 498].

ESMARCH (F.). **Die Fusskrankheiten des Getreides.** [The foot diseases of cereals.]—*Die kranke Pflanze*, i, 4, pp. 67–69, 1924.

A brief account is given in popular language of the symptoms and life-history of *Ophiobolus herpotrichus*, parasitic on wheat and occasionally attacking also barley and rye; *Leptosphaeria herpotrichoides* on rye and sometimes on wheat; and *Fusarium nivale* [*Calonectria graminicola*], which occurs on all forms of cereals. Distinction between the diseases caused by these three fungi is stated to be scarcely possible without a microscopic examination.

The two first-named diseases are stated to be controllable only by cultural measures (chiefly crop rotation). *F. nivale*, however, which is transmitted by the seed and through the soil, can be combated by treatment with uspulun, germisan, or fusariol. The sprinkling method is stated to be adequate for the control of *F. nivale* alone, but where smut infection is also to be feared, immersion should be practised.

LUNDEGÅRDH (H.). **Ueber die Interferenzwirkung von Wasserstoffionen und Neutralsalzionen auf Keimung und Wachstum des Weizens.** [The interferential action of hydrogen and neutral salt ions on the germination and development of Wheat.]—*Biochem. Zeitschr.*, cxlix, 3–4, pp. 207–215, 5 diag., 1924.

In continuation of his work on the reaction of *Gibberella*

saubinetii to the hydrogen-ion concentration of the medium in the presence of various salts [see this *Review*, iii, p. 545], the author conducted similar investigations on the germination and growth of wheat.

The experiments were carried out on plants of the Svalöf, Pansar, and Thule II varieties in Petri dishes each containing a layer of 50 gm. of fine, air-dry soil. The different P_H values of the soil, a sandy clay with an abundance of humus and a P_H value of 6·8, were adjusted by the addition of varying quantities of HCl solution. After the seeds were sown, the dishes were covered and kept for 48 hours in a dark thermostat at 24° C. On germination the dishes were placed in the window or in the greenhouse. After 10 to 14 days the plants were cut off at soil level and the fresh and dry weight and germination percentage determined.

The action of Ca and H ions was investigated in ten replications of 200 plants. The calcium was added in the form of two concentrations of chloride, 0·5 and 5·0 c.c. N/10 solution per 50 gm. of soil, 25 to 35 c.c. of water being given at the beginning of the test. The growth of the plants without Ca at P_H 5·2 was only $\frac{1}{5}$ of that at 6·8. In the presence of Ca ions the curve was less abrupt. From P_H 6·1 towards neutrality the Ca ions favoured more or less the development of the plants in comparison with the controls, until the vicinity of the neutral point (P_H 6·8 to 6·5) was reached, when the action of the calcium appeared to produce a slight check in growth exactly as in the case of *G. saubinetii.*

Potassium chloride and NaH_2PO_4 were also tested. The effects of the former resemble those of Ca, inasmuch as the maximum action occurs in the definitely acid region. The arrest of development produced by the H ions was almost completely adjusted by these salts at P_H 5·65 and 4·3. In very acid soil (P_H 3·0), however, the toxic action of the ions was reinforced, and this also appears to be the case with the other salts.

In slightly acid soil (P_H 6·5) potassium chloride exerted a very favourable influence on growth. The curve then sinks abruptly and it is questionable whether potassium chloride neutralizes the toxic action of the H ions by true ion antagonism. It is possible that the potassium acts as a general stimulant, and thus balances the toxicity of the H ions. Phosphate acted similarly in the case of *G. saubinetii.* In the region of P_H 5·6 to 4·3 sodium phosphate strongly neutralized the toxic action of the H ions.

A study of the effect of the hydrogen-ion concentration on the germination of wheat seed showed that actual viability was little affected, the deleterious action of unfavourable concentrations being chiefly manifest in the stunting of the root system. In a series of tests in which N/2,000 $CaCl_2$ was added to the soil solution, germination was notably reduced. The low yield obtained in very acid soil (P_H 3) with $CaCl_2$ was apparently correlated with a heavy reduction of germination, while in the region of moderate acidity (P_H 5·65 and 4·3) these effects were less noticeable and were further outweighed by the vigorous growth of the seedlings that came up.

Zade (A.). **Neuere Untersuchungen über die Lebensweise und Bekämpfung des Haferflugbrandes (Ustilago avenae [Pers.] Jens.).** [Recent investigations on the life-history and control of loose smut of Oats (*Ustilago avenae* [Pers.] Jens.).]—*Angew. Bot.*, vi, 2, pp. 113–125, 1924.

In continuation of his previous investigations on the infection of oats by loose smut (*Ustilago avenae*) [see this *Review*, ii, p. 214], the author again sowed seed dusted with spores after the removal of the glumes, the results obtained being similar to those of the earlier test. It was further observed that the incidence of disease was much higher in the plants arising from infected inner grains (i. e., those of the second flower in the spikelet) than in those from the large outer grains of the first flower. Probably the small, weak grains are in general more liable to smut than the large ones, in which case their exclusion from the seed material should prove a valuable step towards the control of the disease. The fact, now definitely established, that the spores adhering to the exterior of the glumes are virtually incapable of causing infection excludes all possibility of the dissemination of the disease by means of sacks, implements, and the like. This does not apply, of course, to grains which have lost their glumes in threshing.

The negative results obtained by dusting spores on the exterior of the glumes are explained by the fact that the seedling cannot be infected from spores in such a situation until it has traversed the length of the glumes, a distance of about 1 cm., by which time it is no longer so susceptible as when emerging from the caryopsis. Moreover, the spores on the glumes are generally incapable of forming sufficiently long hyphae to reach the seedling. It is obvious that the spores within the glume are much more favourably situated as regards the possibility of infection. Infection from the soil is even less probable than that from the outside of the glumes.

Spores applied to the ears during flowering took considerably longer to germinate in 1923 than in 1922 (four days instead of one), probably owing to a deficient secretion of the stigmas in consequence of the heat. The frequent germination of the spores without conidial production was also very striking in 1923. Branches of the mycelial hyphae, especially in the anthers, stigmas, and glume parenchyma, frequently formed gemmae, i. e., biscuit- or dumb-bell-shaped swellings, sometimes emerging from the hyphae like chains of beads. These gemmae, which also arose as transformation products of the conidia, evidently constitute an important resting stage of the fungus, germinating simultaneously with the seed.

The mycelium was occasionally found in 1923, in a rudimentary form, in the epidermis of the caryopsis, and it occurred also in the epidermal hairs of the bare grain, the parenchyma layer of the inner wall of the glumes, the remains of the anthers and stigmas, and, in isolated cases, in those of the lodicules.

The conidia proved to be viable only for six weeks at the most, and can hardly be regarded as important agents of dissemination, the latter function evidently being performed by the gemmae, while the mycelium itself, which in recent experiments was found

to be viable after months of desiccation, also constitutes a resting stage of the fungus.

Inoculation experiments were undertaken in 1923 on *Avena strigosa, A. brevis*, and *A. nuda*, with the result that only the last named became infected. The following simple and effective laboratory method of infecting the glumes and anthers of ripe grain was devised. Spores sown on a decoction of sterilized fragments of glumes and anthers germinated in enormous numbers, the resulting mycelium becoming established in the parenchyma of the glumes and anthers. The infected portions were inserted into healthy seeds in such a way that the seedling must necessarily come into contact with them. The tedious process of blossom infection in the field is thus rendered superfluous.

Control of oat smut can only be effected by a fungicide which will destroy, not only the comparatively few spores between the glume and the seed, but also the resting mycelium in the parenchyma of the glumes, anthers, and stigmas as well as the gemmae. Probably formaldehyde, which has no adverse effects on oats, as in the case of rye and wheat, is most likely to meet these requirements.

HAYES (H. K.), STAKMAN (E. C.), GRIFFEE (F.), & CHRISTENSEN (J. J.). **Reaction of Barley varieties to Helminthosporium sativum. Part I. Varietal resistance. Part II. Inheritance studies in a cross between Lion and Manchuria.**—*Minnesota Agric. Exper. Stat. Tech. Bull.* 21, 47 pp., 10 figs., 1923. [Received Sept. 1924.]

A study of varietal resistance in barley to *Helminthosporium sativum* [see this *Review*, iii, p. 27] was made by sowing each variety in a 5-foot row and spraying the plants at heading time with spore suspensions of the causal organism. Yield tests of the same varieties were made in a separate field in replicated rod rows. A correlation coefficient between yield and severity of infection, as tested in this manner, for 17 six-rowed strains, was obtained of $+0{\cdot}575 \pm 0{\cdot}109$, while for 39 purified smooth-awned hybrids it was $0{\cdot}445 \pm 0{\cdot}087$.

Varietal resistance and susceptibility, though tending to persist from year to year, were shown to be relative characters, and the degree of infection was widely influenced by environmental conditions. All degrees of resistance and susceptibility were obtained within the hulled, six-rowed group. Barleys of the Manchuria type proved rather resistant, though one strain of Manchuria was more susceptible each year than the others. Mariout and Bay Brewing were extremely, and Trebi and Lion rather, susceptible. The new six-rowed variety Minsturdi, which excels in strength of straw, appeared resistant. In the naked-bearded, six-rowed group, Himalaya seemed susceptible and Black Hull-less and Nepal resistant. Most of the common two-rowed varieties showed resistance. Three barleys belonging to the *Hordeum intermedium* group were susceptible, while both resistant and susceptible varieties were found within the *H. deficiens* group.

In order to express the correlation of the severity of infection of the same strain in different years, the correlation coefficient was

calculated for the 49 varieties grown in 1920 and 1921 and was found to be $0{\cdot}497 \pm 0{\cdot}073$, while for the 67 varieties grown in 1921 and 1922 the coefficient was $0{\cdot}616 \pm 0{\cdot}051$. Correlation coefficients were further calculated to express the extent to which infection in one part of a plant may be used to estimate that in another part of a plant of the same variety; they ranged from $0{\cdot}362 \pm 0{\cdot}073$ to $0{\cdot}463 \pm 0{\cdot}047$ in 1921, while all three coefficients (i. e., for foliage, roots, and spikes) were between 0·7 and 0·8 in 1922.

Seedlings of 98 barley varieties were grown in the greenhouse in soil inoculated with cultures of *H. sativum*, and notes were taken on root infection. The correlation coefficients expressing the relation between root infection in the greenhouse and in the field were between 0·3 and 0·4.

Crosses between Lion, a six-rowed, black, smooth-awned, susceptible variety, and Manchuria, a six-rowed, white, rough-awned, resistant variety, were used to determine the mode of inheritance of the differential characters. The rough-awned character proved dominant to smooth awns, and in the F_2 the ratio of rough- to smooth-awned plants was approximately **3 : 1.** The rough-versus smooth-awn character was apparently dependent on a single factor difference, whereas the degree of smoothness of the awn seemed to be due to modifying factors presumably introduced by the rough-awned parent. Black versus white colour was apparently dependent upon a single genetic factor inherited without reference to the main factor difference for rough versus smooth awn.

Spore suspensions of *H. sativum* were sprayed on 124 F_3 lines of the Manchuria-Lion cross containing 25 plants each. On the basis of the individual plant data for susceptibility or resistance all the F_3 lines were selected which appeared as resistant as Manchuria or as susceptible as Lion and were again tested in the F_4. By this method eight lines were obtained which were as susceptible in both F_3 and F_4 as Lion, and 6 lines approximately as resistant as Manchuria. The correlation coefficient for the degree of infection in F_3 and F_4 of 36 hybrid lines of Lion × Manchuria was $0{\cdot}256 \pm 0{\cdot}105$.

The 36 hybrid families were tested for root infection under greenhouse conditions in 1922–23. The correlation coefficient for average severity of infection under field conditions for F_3 and F_4 as related to root infection under greenhouse conditions was $0{\cdot}426 \pm 0{\cdot}092$.

Resistance and susceptibility to *H. sativum* are therefore inherited characters but apparently dependent on more than one genetic factor.

A higher proportion of the resistant families was of white colour and rough awn than of susceptible families; within the 124 F_3 lines grown, however, all combinations of resistance and susceptibility, smooth and rough awn, and black versus white colour were obtained.

TIEMANN (O. P.). **Physical characteristics of disease-free seed Corn.**—*Journ. Amer. Soc. Agron.*, xvi, 1, pp. 37–40, 1924.

The organization and work of the Illinois Seed Corn Testing

Laboratory, Bloomington, Illinois, is described. Each lot of seed maize from the germinators (where six kernels are kept for about six days at uniform temperature with regular watering) is carefully examined and divided into three parts: (1) disease-free; (2) slightly diseased; and (3) severely infected. These different grades are returned to the farmers with the suggestion to plant only the first two grades, which should be kept separate for selection purposes.

During the winter of 1922–23, about 4,000 bushels (over 350 lots) of seed maize from Illinois and Indiana were individually ear tested in the laboratory. Thirty per cent. of the ears, representing a potential maize acreage of 9,600 acres, were badly diseased and discarded as unfit for seed. Large, dull lemon-yellow coloured ears of rough or fairly rough indentation showed a high percentage of disease, while those of a very bright golden-yellow and with a good depth of kernel and medium smooth indentation gave excellent results as regards viability, immunity from disease, and vigour of the root system. The indentation factor is applicable to both yellow and white maize. In the latter case pearly white are preferable to milky white ears.

LINDFORS (T.). **Böra vi beta rågen?** [Ought we to steep Rye seed?]—*Landtmannen*, viii, 33, pp. 620–621, 1 fig., 1924.

The average increase of yield from the disinfection of rye seed for the control of the snow mould (*Fusarium minimum*) [*Calonectria graminicola*] at the Stockholm Agricultural Experiment Station during the 1923–24 season is represented at 70 per cent. The results of experiments carried out in Östergötland and Dalarne were most favourable for tillantin C; germisan and uspulun followed in the order named. Roggenfusariol and a Swedish product of the same composition were also tested with less satisfactory results. Sprinkling was in no case as efficacious as immersion.

ARRHENIUS (O.) & HENNING (E.). **Den växthygieniska betydelsen av lerslagning eller sandkörning av uppodlade kärr-eller mossmarker. III. Fält och kärlförsök samt fysikaliska och kemiska undersökningar.** [The value of clay or sand as fertilizers for crops grown in reclaimed swamps and bogs. III. Field and pot experiments with physical and chemical investigations.]—*Medded. Centralanst. for forsöksväsendet på jordbruksområdet*, 264, 23 pp., 1 col. pl., 3 diag., 1924. [English summary.]

In continuation of previous investigations [see this *Review*, i, pp. 209, 210], the correlation between the incidence of yellow tip of oats and the physical and chemical constitution of the soil was studied.

Field experiments were conducted in 1923 on the following plan. Twelve plots 3 by 10 m. were divided into three series of four, of which one plot was left untreated, one received a complete fertilizer, one was given 100 cb. m. of clay per hect., and one received both clay and superphosphate. The incidence of yellow tip was highest on the plots receiving the complete fertilizer and on the

untreated, the disease being present also to a slight extent on the plots treated with a mixture of clay and phosphate, while it was entirely absent from those receiving clay alone. The yield on the clay plots was five times as high as that on the untreated (4·83 kg. of grain per plot against 0·93 kg.); with the addition of phosphate the increase was four times (3·58 kg.), while the yield from the complete fertilizer plots was slightly lower than that of the untreated (0·90 kg.). The results of experiments carried out from 1918 to 1921, and here briefly summarized, showed that only clay consistently increased the yield and reduced the incidence of yellow tip, while the complete fertilizer and superphosphate produced a uniformly adverse effect both on the health and yield of the crop. The results of lime applications were conflicting.

It has frequently been suggested that the real cause of the disease lies in the physical conditions of the soil, and a series of investigations [details of which are given] was therefore made on the physical properties of clay, peat, and intermediate mixtures. The data obtained by these experiments showed that by the application of clay to a peat soil some of the water conditions are improved while others are not. They indicated that neither the physical conditions, temperature, nor acidity of the soil can be regarded as primary factors in the causation of the disease. There is some reason to believe that the oxidation-reduction potentials of the soil are involved, but this question must be left open until the technique for their determination can be perfected.

Experiments were conducted to test the validity of the theory that the difference between healthy and diseased soils lies in the phosphate content. When percolating diseased and healthy soils it was found that the phosphate content was lower in the latter than in the former. The results of pot experiments in which varying amounts of superphosphate were added to pure peat confirmed previous data as to the detrimental effect of phosphates. No disease was present on the untreated peat or on that receiving a small quantity of phosphates, whereas on that receiving medium and large doses the incidence of yellow tip was very high. These data are regarded as confirming previous evidence to the effect that a high phosphate content of the soil solution is one of the principal factors in the development of yellow tip of oats.

In pot experiments the beneficial effects of clay applications, both as regards the reduction of yellow tip and the increase of yield, were confirmed. In one case the yield of grain was augmented from 146 ± 20 to 308 ± 20 gm. Good results with regard to yield were also secured by the application of lime, silica, or magnesium, the last-named, however, exercising no influence on the disease.

BIRMINGHAM (W. G.). **Black spot on dried Orange peel from China.**—*Agric. Gaz. New South Wales*, xxxv, 5, p. 345, 1924.

Dried orange peel imported into New South Wales from China in 1920, for use in Chinese restaurants, was found on examination to be covered with typical black spots bearing the pycnidia and spores of *Phoma citricarpa* McAlp. The disease has been previously recorded from Canton, Hongkong, Swatow, Amoy, and

Foochoo in China, and is reported to occur in Shanghai. Lee, who isolated and proved the pathogenicity of the fungus in China, does not refer to the spermatium-like bodies (or X spores) which the author, in agreement with Darnell-Smith, found repeatedly prior to or associated with the extrusion of the ordinary spores.

TUCKER (C. M.). **La pudrición del cogollo del Cocotero en Puerto Rico.** [Coco-nut bud rot in Porto Rico.]—*Rev. de Agric., Puerto Rico,* xii, 6, pp. 385–390, 2 pl., 1924.

Bud rot of the coco-nut in now reported from Porto Rico, where it is spreading along the western coast; the Mayagüez district, which is the most affected, is estimated to have lost 25 per cent. of the palms.

The disease, the symptoms of which are given, is stated to correspond to that described in Jamaica, India, and the Philippines, and not to resemble the Cuban type. It is infectious, and the organism which causes it (the consideration of which is deferred) appears to be transmitted from diseased to healthy trees by birds, insects, and the wind. The rate of spread seems to be accelerated during the rainy season. The recommendations for its control include the cutting out of diseased trees immediately the first symptoms are noticed, frequent inspection of plantations, and a concerted action of all planters in the infected area to restrict its spread. [This article has been reprinted in English in *Tropical Agriculturist,* lxiii, 2, p. 89, 1924.]

RAGUNATHAN (C.). **The occurrence of teleutospores in Hemileia vastatrix B. & Br.**—*Ann. Roy. Bot. Gard., Peradeniya,* viii, pp. 109–115, 1924.

This is a somewhat fuller account of the occurrence of teleutospores in *Hemileia vastatrix* already noticed from another source [see this *Review,* ii, p. 585].

SHEARER (E.). **Cotton wilt.**—*Third Ann. Rept. Cotton Res. Board, Min. Agric. Egypt, 1922,* pp. 37–40, 1924.

Several forms of cotton wilt have been found to exist in Egypt, and there is some evidence that the different types are more or less confined to definite tracts of country.

The first form, occurring in Beheira and Sharquîya, may be referred to as *Fusarium* wilt to distinguish it from an obscure type, known as root rot wilt and apparently associated with a species of *Rhizoctonia,* prevalent in Gîza and Beni Suef. A third type, also found in Beheira, is believed to be due to overwatering.

Fusarium wilt is usually manifest early in the season, the leaves showing a characteristic 'mosaic' appearance before they actually wither. The woody root tissues exhibit a brown discoloration and are occupied by hyphae blocking the water-conducting vessels. Isolations from portions of infected roots yielded a fungus which, when sub-cultured on an acid rice medium, is stated to agree morphologically and culturally with the *Fusarium* stage of *Neocosmospora vasinfecta.* Inoculation experiments were carried out on healthy Sakel cotton seedlings in pots with results which left no doubt as to the pathogenicity of the fungus. In two small

field tests, one with seedlings and the other with older plants (3 months), the results in the former case were positive and in the latter negative, indicating that the plants are susceptible only at an early stage of development.

Root rot wilt produces quite different symptoms from those described above. It occurs at a more advanced stage in the development of the plants (3½ months) and is marked by a vivid red discoloration of the leaves, petioles, and stems. Later the leaves turn yellow and fall. In the early stages only the cortex of the roots is affected, the woody tissue not being attacked until the disease is far advanced. Minute black sclerotia belonging to a species of *Rhizoctonia* were found in the decaying cortex, but inoculation experiments gave negative results. A similar disease is stated to occur in India.

Wilted cotton plants, grown as a reclamation crop on saline soil, showed a constriction and deep cracking of the stems for about two inches above soil level. The plants were subjected to extremely heavy and prolonged irrigation, which was presumably responsible for the abnormal condition, since there was no trace of any parasitic organism.

Shearer (E.). **Sore-shin.**—*Third Ann. Rept. Cotton Res. Board, Min. Agric. Egypt, 1922*, pp. 27–37, 3 diag., 1924.

Most of the work on sore shin of cotton [*Corticium solani*] in 1922 consisted of control experiments, the first of which was designed to test further the efficacy of the naphthalene-gypsum seed dressing recommended by Balls (*Year Book Khed. Agric. Soc.*, 1906) and already tried, with negative results, in 1921. The results of the 1922 tests were very inconsistent, marked benefit being derived from the treatment in one case (especially with 3 per cent. naphthalene), while in two others no improvement was effected. In these experiments, as in those of Balls, the best results were obtained on very bad soil, where the naphthalene vapour is retained for much longer than on well-cultivated land. There were no signs of any stimulation of germination from the treatment, as claimed by its originator. The naphthalene treatment, therefore, cannot be recommended for general use.

The application of a heavy dressing of lime failed to control the disease or increase the yield, while light extra watering was also without effect. The most suitable time for sowing in the Gîza district was found to be the middle of March, thus confirming the conclusions reached by Balls.

Reiners (A. H.). **Mold and mildew.**—*Textile World*, lxv, 13, pp. 41, 45, 119–120, 1924.

Attention is called to the fact that during the various stages of manufacture cotton fabrics become thoroughly seeded with fungous spores which only await a favourable opportunity for development. At a comparatively low moisture content the organisms most likely to develop are moulds of the *Aspergillus* type, including *A. niger*, *A. glaucus*, and various white, yellow, and brown species of the genus. Members of the genera *Penicillium* and *Mucor* occur at a slightly higher moisture content, the most familiar being the

common *P. glaucum*, which appears to be a collective name for several species.

In experiments in which fabrics were exposed to an atmosphere practically saturated with moisture, it was found that the first goods to mildew were those which had been heavily sized with little or no preservative in the size; the next, goods lightly sized with the same type of substance; heavily sized fabrics with the proper amount of preservative showed no mildew for two months; while lightly sized material properly preserved displayed no trace of damage after three months' exposure.

It was found that the heavily sized fabric contained a considerable percentage of hygroscopic substance which absorbed so much water that the goods became wet and the preservative was gradually soaked out, permitting the development of the mould spores after two months.

Unsized filling yarn was found to develop mildew, while properly sized warp yarns did not.

Cotton itself contains all the ingredients necessary for the development of the mildew organisms, though in a less accessible form than the starch paste used in sizing. This is why sized goods which do not contain sufficient antiseptic develop mildew more quickly than unsized fabrics.

Since it is impossible to prevent the mould spores from contaminating the fibre during manufacture, the best means of control are to lower the moisture content of the fabric so that no growth can take place, and to size the yarn or cloth with material containing sufficient antiseptic to prevent the development of moulds under any conditions. The former method is recommended only in the case of goods for export, as the drying of the fabric results in 3 or 4 per cent. loss of weight. Care should be taken not to apply an excess of antiseptic, which is apt to affect the finish of the material.

SPEARE (A. T.) & YOTHERS (W. W.). **Is there an entomogenous fungus attacking the Citrus rust mite in Florida?**—*Science*, N.S., lx, 1541, pp. 41–42, 1924.

The authors see in the fact that the mite (*Phyllocoptus oleivorus* Ashm.) causing citrus 'rust' in Florida always becomes more abundant on trees sprayed with copper mixtures, as proved by copious data on record, and in the discovery of fungal filaments on the surface and fungal bodies in the inside of these mites attacked by an apparently destructive disease [the chief symptoms of which are briefly given], considerable evidence of the existence of an entomogenous fungus which helps to control the attacks of this mite in Florida. No description of the fungal bodies in question is given.

PRÁT (S.). **Die Pilze in den Wespennestern.** [Fungi in Wasps' nests.]—*Ber. Deutsch. Bot. Gesellsch.*, xlii, 5, pp. 225–226, 1924.

Some years ago it was observed that the paper-like sheaths of wasps' nests and the woody material of which they are made were entirely penetrated by brown fungous hyphae and spores similar to

those described by Möbius [see this *Review*, iii, p. 563] as responsible for the grey discoloration of exposed timber.

Two species of moulds were isolated from this material, one belonging to the Dematieae (*Dematium*?) and the other an *Alternaria* resembling *A. tenuis*. Filter paper, cotton wool, and fir splinters were moistened with diluted Liebig's extract, placed in flasks, and inoculated with the isolated fungi. In a year both organisms had produced the typical characters shown by the infested sheaths found in the nests. On drying the cultures the grey tinge of the paper and cotton wool, as well as the silver-grey sheen characteristic of affected material, were strikingly apparent.

The same fungi have been observed in wasps' nests in various parts of Czecho-Slovakia. It is thought that the hyphae contribute to the toughness of the sheaths, since both species produce large quantities of mucilage in sugar solutions and the brittle nests of *Vespa crabro* are almost entirely devoid of fungi.

JOSHI (S. D.). **The wilt disease of Safflower.**—*Mem. Dept. Agric. India*, Bot. Ser., xiii, 2, pp. 39–46, 3 pl., 1924.

The wilt disease of safflower (*Carthamus tinctorius*)—a crop of increasing economic importance in India on account of the oil and dye it yields—was for the first time observed doing serious damage at Pusa in 1920, when practically all the varieties under cultivation there were attacked, up to 30 per cent. of the plants in some varieties being affected at flowering time. Later it was also found at Sankni in the district of Bulandshahr, United Provinces. Local cultivators hold that the disease is of more common occurrence in years of abundant rainfall and the extent of damage varies according to the weather conditions at the time of infection. In Pusa in 1920 the humidity in February and March was high and there were a few cases of infection at the end of January, the severe attack occurring later.

The first symptom is a slight yellowing of the leaves of apparently healthy plants, followed quickly by the drying up of the whole plant. At this stage a dense white growth of mycelium can be found at the collar. Just below the soil level the crown and roots bear large, loosely attached, black sclerotia, from 2 to 12 mm. in length and very irregular in shape, generally roundish or elongated. Similar sclerotia are also found inside the stems. The cortical tissue in the lower part of the stems shreds easily. A characteristic feature of the diseased plants at an advanced stage of attack is the ease with which the flower heads break off, leaving the outer involucre of bracts; this condition is due to the development of a large, black, pear-shaped sclerotium in the thalamus, and to the latter changing into a powdery mass.

In pure cultures the fungus produces a mycelium closely resembling the typical *Rhizoctonia* form. Sclerotia develop at first as white, hard bodies on the surface of the mycelium, from which they can be easily detached; later they turn black, but usually remain covered by a semi-persistent, thin, mycelial membrane. The two or three outer layers of cells are brownish-black, and the interior of the sclerotium, formed of somewhat

loosely interwoven hyphae, is usually white, but may be pink when young.

Branched, tufted appressoria, comparable to those described in *Botrytis* and *Sclerotinia*, are frequently formed. Perfect apothecia were not obtained, but in a few cases the sclerotia, placed on moist earth in Petri dishes, developed brownish stalks with distinct apothecial cups at the top but without forming asci. These were up to 1 cm. long, while similar stalks produced in cultures reached a height of 2 cm.

In the cultures a conidial stage was produced after 9 or 10 days. The fertile hyphae bear conidiophores which may branch to form a cluster of sterigmata, at the tip of which chains of microconidia, 3 to 5 μ in diameter, are formed. All efforts to induce the conidia to germinate failed.

Inoculation experiments on safflower seedlings with fragments of hyphae from pure cultures gave positive results, the seedlings rotting very rapidly. The fungus spread through the soil to neighbouring healthy plants and soon killed them. Large plants with hard tissues took longer to rot. The spread of the mycelium within the host depends on the maintenance of humid conditions, the progress of the fungus being entirely checked when the plant is placed in dry open air. The mycelium grows in the soft tissues of the leaf and stem, which it changes into a soft pulpy mass. It also grows in the pith of the stem, where it forms large black sclerotia.

A few other plants besides safflower were also found infected in the field with this fungus, and cross-inoculation experiments showed that wheat, oats, gram [*Cicer arietinum*], mustard [*Brassica campestris* var. *sarson*], pea, potato, and the common weeds *Chenopodium album* and *Asphodelus tenuifolia* are highly susceptible, while *Melilotus indica* proved to be entirely immune.

The sclerotia of the fungus do not seem to remain viable for very long periods, only 14 per cent. germinating one year after development whether in the field or in cultures. They are killed by immersion in water at 50° C. for five minutes.

The author considers that the fungus should be referred to *Sclerotinia sclerotiorum*, and attention is called to the similarity of the safflower disease and that of the sunflower caused by this species [see this *Review*, iii, p. 274]. Comparison with *Rhizoctonia napi* West., as described by Shaw and Ajrekar (*Mem. Dept. Agric. India*, Bot. Ser., vii, 4, 1915), suggests the complete identity of the two organisms in regard to morphology, the range of host plants, and the symptoms they produce.

As practicable control measures the collection and destruction of all infective material in the field, and a deep ploughing and clean weeding of the soil are recommended.

DOWSON (W. J.). **Contributions from the Wisley Laboratory. XLIV. A new disease of Sweet Peas.**—*Journ. Roy. Hort. Soc.*, xlix, 2, pp. 211–221, 2 pl., 3 figs., 1924.

The occurrence of a new disease of greenhouse and outdoor sweet peas [*Lathyrus odoratus*] is recorded. Plants submitted to Wisley for inspection in July 1922 showed symptoms resembling

those of mildew on both surfaces of the leaves and wings of the stems, which were covered with a white, mealy powder occupying more or less of the surface; the latter was slightly sunken and (under the larger patches) of a faint buff colour. The patches were diffuse and without sharply defined margins. In 1923 the disease was again reported from the same source and from the Isle of Man, and was later observed at Wisley. The symptoms were found to be produced by a fungus, the conidiophores of which emerged, chiefly from the stomata, in tufts and bore numerous branched chains of nearly round conidia. All parts of the fungus were quite colourless. Its pathogenic nature was demonstrated by repeated inoculation experiments on sweet peas under glass. Negative results were obtained on *Pisum sativum* and *Lathyrus aphaca.* In the successful inoculations leaves with large patches on the surface fell prematurely, and some inoculated seedlings were completely defoliated and died within six weeks after infection. Careful laboratory studies [a detailed account of which is given], led to the identification of the causal organism as a *Cladosporium,* morphologically indistinguishable from *C. herbarum* except in its lack of colour and slightly larger size, but regarded as entitled to specific rank on account of its markedly parasitic character under favourable climatic conditions (high temperature and humidity). It has therefore been named *C. album* n. sp. Reasons are given for not including the fungus in the genus *Ramularia* to which it bears a certain resemblance.

Early applications of sulphur in a fine state of division have been found to give good control of the disease.

ZIMMERMANN (F.). **Dvé choroby skleníkových Karafiátů.** [Two diseases of glasshouse Carnations.]—*Ochrana Rostlin,* iv, 1, pp. 8–10, 3 figs., 1924.

The stock of carnations raised from cuttings in 1923 in the glass-houses of a commercial nursery in Nešvícy [Czecho-Slovakia] was almost entirely destroyed by a severe outbreak of *Fusarium dianthi* Prill. & Del. The fungus, which is stated to gain access to the plants chiefly through the wounds made when taking the cuttings, primarily attacks the roots, causing rapid wilting and finally the death of the plants. Conidial sporodochia, from 0·5 to 0·7 cm. in diameter, appear usually on the dead stems in the vicinity of the collar and bear numerous falcate, slightly curved conidia, 35 by 3 μ in size. Pure cultures of the fungus were readily grown on carnation agar and in 14 days gave rise to sporodochia somewhat smaller in size than those on the host.

Considerable damage was done to carnations in the same nursery by a hitherto unnamed *Alternaria,* which in the author's opinion is probably a variety of *A. brassicae* for which he proposes the term var. *dianthi.* The characteristic symptom of the disease is the sudden death of the flower-buds on entirely healthy plants without any apparent cause. The presence of the fungus in the dead buds can be detected by cultures in carnation decoction agar or by keeping the dead buds in moist chambers until the fructifications appear. The chains of conidia are borne on brown conidiophores 25 to 35 μ in length and 5 to 6 μ in breadth, generally with

2 or 3 transverse septa. The conidia are chiefly of two forms: (*a*) oblong-obclavate, with from 6 to 10 transverse septa, rarely divided by longitudinal walls, 60 to 100 μ long and 12 to 15 μ broad; and (*b*) somewhat similar in shape but shorter and thicker, 23 to 45 μ long by 14 to 17 μ broad, divided by 3 to 5 longitudinal [? transverse] and generally by 2 transverse [? longitudinal] septa. Both forms are distinctly constricted at the septa and are of a darker colour than the conidiophores.

Bondartzeva-Monteverde (Mme. V. N.). О новом грибке на ветвях Сирени. [A new fungus on the branches of Lilac.]—*Болезни Растений* [*Plant diseases*], *Monitor Phytopath. Sect. Chief Bot. Gard., R.S.F.S.R.*, xii, 3, pp. 83–85, 1923. [Received 1924.]

In the spring and summer of 1920 the author observed a diseased condition in some well-grown lilac bushes (*Syringa vulgaris*) in the Shuvalovo Park near Leningrad. The great majority of the bushes, which had suffered rather badly at the hands of the public, bore a fungus, the fructifications of which covered elongated patches on the dead stems and branches. This fungus was also found attacking living branches, by preference those of which the tops and lateral twigs had been broken off, but which were still producing fresh shoots with developing leaves. It is therefore believed that the fungus is a semi-parasite, capable of penetrating woody tissues weakened by some previous injury. Careful investigations during the following years failed to reveal its presence elsewhere around Leningrad.

The fungus belongs to the genus *Dothiora* and the author names it *D. syringae* sp. nov. The fructifications are up to 1 mm. in length, 500 μ in breadth, and from 250 to 300 μ in height. They are angular, rounded, or irregularly elongated in shape, much flattened at the top and bottom, and closely adpressed to one another. At first they develop under the epidermis, subsequently breaking through to the surface in elongated fissures. Their apical portion remains long closed but finally ruptures and liberates the asci, leaving whitish pits in the stroma which remains embedded in the bark. The stroma is composed of polygonal pseudoparenchyma with cells from 5 to 8 μ in diameter; in the peripheral portions these cells have thick and dark-coloured walls, while in the parts surrounding the ascigerous cavities the walls are thin and light-coloured. The layer of asci is usually disposed in the form of a broken irregular ring around the central portion of the fructifications. The asci are collected in groups frequently separated from one another by fairly broad layers of stromatic tissue. Within the groups each ascus occupies a separate cavity separated from the neighbouring asci by a narrow layer of thin and greatly elongated cells. Thus each of the asci, which stand in a single vertical layer parallel to one another, is enclosed in a separate cavity the walls of which resemble paraphyses and are termed 'paraphysoids' by the author. The asci are sessile, cylindrical, 80 to 140 by 12 to 16 μ, without true paraphyses, and contain 8 spores in one or two rows. The spores are ovate-oblong, tapering somewhat at the base, hyaline, frequently constricted in the middle,

with 3 or 6 transverse septa and sometimes a longitudinal wall in some of the cells, and 20 to 28 by 8 to 10 μ in diameter.

In pure cultures the ascospores always gave rise to numerous conidia, the substratum being sometimes covered with a pinkish, slimy layer of budding spores. A hyaline, filamentous mycelium then developed, which gradually assumed a dark brown colour. Sclerotium-like bodies, up to 2 mm. in diameter and composed of closely intertwined, toruloid mycelium easily breaking up into separate cells, developed in many of the cultures.

A Latin diagnosis is appended.

EREMEYEVA (A. M.). Некоторые наблюдения над заражаемостью ржавчиной Подсолнечника и Дурнишника. [Some observations on the susceptibility of the Sunflower and *Xanthium strumarium* to infection by rust.]—*Болезни Растений* [*Plant diseases*], *Monitor Phytopath. Sect. Chief Bot. Gard., R.S.F.S.R.*, xii, 1, pp. 14–15, 1923. [Received 1924.]

Experiments carried out in 1922, in which plants of *Xanthium strumarium* were inoculated with teleutospores of *Puccinia helianthi*, gave negative results. These results were not conclusive as only a low percentage of the teleutospores used were viable, although seedlings of sunflower simultaneously inoculated with them contracted the disease. Later on two plants of *Xanthium* were inoculated with fresh aecidiospores directly collected from sunflowers, and one developed a few uredosori on two of its leaves; the uredosori soon disappeared, however, and the plant finally recovered. The plants of *Xanthium* which had escaped artificial infection were then planted next to a sunflower plant covered with uredosori and on which the teleutospores were beginning to appear. In this case the results were positive; on the under side of the leaves soon appeared numerous uredosori followed by teleutospores. It is noteworthy that in 1922 *X. strumarium*, a frequent weed in sunflower plantations in the government of Kharkoff, was free from the rust, although, as a general rule, it is heavily attacked by it in that region.

CIFERRI (R.). **Esperienze sulla propagazione della batteriosi fogliare del Trifoglio e sulla lotta mediante la sterilizzazione parziale del suolo.** [Experiments in connexion with the spread of leaf bacteriosis of Clover and on its control by means of partial sterilization of the soil.]—*Staz. Sperim. Agrar. Ital.*, lvii, 4–6, pp. 165–177, 1924.

In this paper the author describes the symptoms of a bacterial leaf spot of *Trifolium pratense* and, in a lesser degree, of *T. incarnatum*, grown in the Macetarese and Albese districts of Italy. Although he has not isolated the causal organism, he is satisfied that the Italian disease, which is progressively increasing in severity, is identical in every respect with that recently described as affecting several species of clover in North America and due to *Bacterium trifoliorum* [see this *Review*, iii, p. 263]. The American disease was stated by its investigators to differ in essential respects from one described on clover in Italy in 1896 by Voglino, who attributed it to an organism which he named *Bact. trifolii.*

Whether the disease known in Italy as 'incappucciamento' [leaf curl] and recently studied by Manzoni [see this *Review*, i, p. 419; ii, p. 435] is the same as that considered in the present paper is regarded as uncertain. The author has observed the leaf spot and leaf curl in the same field but not on the same plant.

The bacterial leaf spot is thought by the author to be carried in the soil, in which the organism is believed to live and from which it infects the crop by being carried on to the leaves through the splashing of rain and also by the wind. The fact that second and third crops show more infection than the first is explained by the close proximity to the soil of the young shoots of the new growth after the clover has been cut. To this must be added the lessened vigour and consequent lowered resistance of the plants after each cutting. The organism is apparently capable of retaining its viability after passing through the digestive canal of animals, since dung was found by the author to be capable of infecting healthy plants.

Preliminary experiments in the control of the disease showed that partial sterilization of the soil with arsenate of soda at the rate of 50 kg. per hect. not only reduced its incidence to a minimum but also increased the general vigour of the plants.

ROSE (D. H.). **Diseases of Apples on the market.**—*U.S. Dept. of Agric. Bull.* 1253, 24 pp., 8 graphs, 1924.

During the period 1916 to 1920 the average annual commercial apple crop (i. e. that grown for selling) was estimated at 80,337,000 bushels, or 45 per cent. of the total apple production of the United States, with a minimum value (in 1920) of $115,551,000. Estimates of losses from diseases in the orchard (quite apart from those occurring subsequently as a result of unsuitable storage conditions, &c.), were estimated in 1919 at 5 to 12 per cent. of the whole.

The data presented in this paper were collected during the period 1917 to 1921 by the Food Products Inspection Service of the Bureau of Markets (now Agricultural Economics), and comprise analyses of the incidence of disease as calculated by crops (box or barrel), varieties, and locality. Considering the period covered by the inspections as a whole, blue mould [*Penicillium expansum*] was the most prevalent disease. In the box crop scald [see this *Review*, iii, p. 215] was second, and decay (including a number of unspecified fungous rots) third; in the barrel crop decay came second, followed by black rot [*Physalospora cydoniae*]. Twelve diseases were reported in the box and eighteen in the barrel crop, of which eight were common to both. The diseases occurring in the box crop only were anthracnose [*Neofabraea malicorticis*], Jonathan spot [see this *Review*, iii, p. 42], water core, and drought spot; while those affecting the barrel crop only were black rot, brown rot [*Sclerotinia cinerea*], bitter rot [*Glomerella cingulata*], *Rhizopus* rot, pink mould [*Cephalothecium roseum*], grey mould [*Botrytis* sp.], blotch [*Phyllosticta solitaria*], rust [*Gymnosporangium juniperi-virginianae*], fruit spot [*Phoma pomi*], and sooty blotch [*Phyllachora pomigena*]. Diseases common to both crops were blue mould decay, scald, *Alternaria* rot, scab [*Venturia inaequalis*], soft scald,

bitter pit, and internal breakdown [see this *Review*, iii, p. 145]. The disease index in the barrel crop was 16·8 and that in the box crop 12·6, the difference between the two being apparently largely due to the greater variety of rots in the barrel crop.

Summer and autumn varieties showed less disease, on an average, than winter or long storage sorts. The box crop showed a steady increase in the percentage of disease from October till June, the barrel crop only from December till June.

Calculating the percentage of scald on the basis of railway cars showing any kind of disease, it is found to be about the same in both crops. If calculated, however, on the basis of cars showing scald, it is more than twice as large in the barrel as in the box crop.

Data from a relatively small number of cars indicate that large apples are more susceptible than small ones to blue mould, decay, scald, internal breakdown, and water core, and that scald is more prevalent among apples in the 'Fancy' than in the 'Extra Fancy' grade.

BAKER (C. E.). **The use of oiled wraps in the prevention of storage troubles.**—*Hoosier Hort.*, vi, 2, pp. 19–24, 1924.

After referring to the recent work by Brooks and his collaborators [see this *Review*, iii, p. 215] on the prevention of apple scald, the writer describes the preliminary results of cold storage experiments conducted at the Purdue Agricultural Experiment Station (Indiana) in the autumn of 1923. In the storage house unwrapped Grimes apples in baskets developed severe symptoms of scald, at a time when the wrapped fruit appeared to be quite sound. Fruit packed in baskets with shredded oiled paper was also apparently in good condition. The greatest amount of scald and rot at the time of examination was found on Grimes apples picked on 5th September, i. e., before reaching maturity. One lot of tree ripe fruit, picked a week later, was put in a warm place immediately, while another lot was held at a cooler temperature for three weeks, after which all the fruit was stored under the same conditions. The former lot showed considerably more scald than the latter, though less than the unripe fruit.

The corresponding consignments of fruit in a commercial cold storage plant were at this time quite free from scald, which frequently develops, however, only when the apples are removed to a warmer atmosphere.

Comparisons are being made of the oiled wrappings supplied by various companies. Among other recent devices are oiled sheets for separating the layers of fruit in the barrel and lining the inside of the package, and wrappers chemically treated with Bordeaux mixture and oiled.

GUBA (E. F.). **Phyllosticta leaf spot, fruit blotch and canker of the Apple: its etiology and control.**—*Phytopath.*, xiv, 5, pp. 234–237, 2 pl., 1924.

In this paper is presented a preliminary summary of the most important results of the author's investigations on the etiology and

control of apple blotch (*Phyllosticta solitaria*) [see this *Review*, iii, pp. 276, 277].

The disease is stated to be present in all States south of the line from North Dakota to New York, and east of New Mexico, Colorado, and Wyoming, except Florida. The distribution of diseased plants from points west of the Mississippi has only been observed of recent years.

The morphology of *P. solitaria* suggests relationship with the genus *Guignardia*, but the author does not accept Shear's identification with the genus *Phyllostictina* [see this *Review*, iii, p. 104], since the emended description of this genus proposed by v. Höhnel is in disagreement with the type species, *P. murrayae* Syd.

The minimum temperature for the growth of the organism in culture is stated to be between 5° and 10° C., maximum between 30° and 35°, and optimum (also for sporulation) between 25° and 30°. The fungus survives long exposure to temperatures far below 0° under cultural conditions.

Development and the formation of pycnosclerotia, i. e., bodies containing a pseudoparenchyma of large cells giving rise to a pycnidium, occur in culture irrespective of light or darkness.

Under Illinois conditions canker enlargement and the formation of pycnosclerotia on the tree may occur in the winter during prolonged, warm, moist periods; the process, however, usually begins in the spring after a spell of quiescence, or in the autumn on the growing cankers or as a result of leaf and fruit infections after July and August. These late pycnosclerotia may either remain sterile or form pycnospores in the next spring. True pycnidia are also formed in the spring. The primary lesions on the fruit and foliage are responsible for much of the summer infections. The pycnidia on the fruit which have already functioned during the season may fill up and become typical pycnosclerotia in the autumn.

During the period covered by the investigations, natural infections occurred in Illinois as early as April and as late as September. Careful determinations by bagging experiments showed that primary infections began between two and three weeks after the fall of the blossoms. The cankers are believed to be the exclusive source of primary inoculum, primary infections from the pycnosclerotia on the mummied fruit and on fallen leaves probably being negligible.

The ascigerous stage of *P. solitaria* has not been traced, but it is believed to exist, as in the case of *Guignardia vaccinii*, *G. bidwellii*, and *G. aesculi*, and to occur rarely on decaying leaves and mummified fruits in the spring, forming one of the final stages of the pycnosclerotium.

Three distinct types of fruit blotch, producing different effects on the tissues, have been observed and may be described as fringed, pitted, and blistered.

The fungus stimulates the host to excessive hyperplasia and the formation of abscission layers. The cambium is not directly affected and the removal of the fungus by the excision of the cankered areas of the bark may be readily effected. In some

varieties the fungus persists indefinitely in the bark, while in others natural excision occurs within three or four years.

Gardner's recommendations [*loc. cit.*] for the control of the fungus by the removal of cankers do not appear practicable to the writer. More feasible methods are the use of disease-free stock, delayed dormant and summer spraying, and proper spacing of bark-susceptible with bark-resistant varieties. Partial control may be ensured by late dormant sprays of lime-sulphur or copper sulphate in concentrated solutions, the spores being killed and remaining in the dead pycnosclerotia. Summer sprays of lime-sulphur at two and three weeks, and Bordeaux mixture at four, six, and ten weeks after the fall of the blossoms give perfect control. The 'two weeks' spray should be (on the trees in southern Illinois) not later than a fortnight after 75 per cent. of the blossoms have fallen. The author's unpublished experimental results indicate that lime-sulphur and Bordeaux mixture are equally effective. For the Duchess and Yellow Transparent varieties a 2–3–4–6 weeks' spraying and for the Benoni a 2–3–4–6–8 weeks' spraying are recommended.

SALMON (E. S.) & WARE (W. M.). **The Pear-scab fungus (Venturia pirina).**—*Gard. Chron.*, lxxv, 1950, pp. 274–275, 4 figs., 1924.

During March 1924 the writers observed the perithecia of *Venturia pirina*, hitherto believed to be known in England only in the *Fusicladium* stage, on dead pear leaves at Wye, Kent. Leaves from North Devon also produced the perithecial stage in abundance, and it is thought that its occurrence may be quite common in England and may hitherto have been overlooked. The life-history of *V. pirina* is briefly described, and control measures to guard against ascospore infection recommended, in addition to those directed against the conidial stage.

It is stated that the perfect stage of both the apple [see this *Review*, iii, p. 584] and pear scab fungi are represented in herbarium material in specimens collected in England in 1866.

SAMUEL (G.). **A Pear tree canker.**—*Journ. Dept. Agric. S. Australia*, xxvii, 9, pp. 880–884, 4 figs., 1924.

A Beurré d'Angleterre pear tree in the Government Experimental Orchard at Coromandel Valley, South Australia, was attacked during the winter of 1923–24 by an undescribed canker.

The cankers, which almost invariably started at a leaf scar on a twig or at the junction of a twig and a branch, had a definitely raised margin and gradually increased in size till they girdled the stem, extending also upwards and downwards. The bark covering affected portions became loosened, flaking off and exposing a dull black area. The disease made rapid headway during the exceptionally wet winter, and in the spring hardly any of the branches produced shoots above the girdled areas. The badly affected wood was removed and the development of the cankers appears to have been arrested.

A species of *Coniothecium* was obtained from the blackened areas. Its identity with *C. chomatosporum*, which produces small, dark specks or raised blisters on the stem and attacks the fruits,

is somewhat doubtful, and further comparative work is needed before the South Australian disease can be definitely attributed to this species.

Excision of the affected parts is recommended, supplemented, if necessary, by a winter spray of copper sulphate or Bordeaux mixture.

MIX (A. J.). **Biological and cultural studies of Exoascus deformans.**—*Phytopath.*, xiv, 5, pp. 217–233, 1924.

Extensive investigations [which are described in considerable detail] on the biology and culture of *Exoascus deformans*, the causal organism of leaf curl of peach, were carried out from 1920 to 1922 in the Kansas Department of Botany.

The fungus was readily isolated from ascospore-bearing leaves, and single-ascus strains were grown in various common culture media, of which sweet potato, carrot, and beet plugs, potato dextrose broth, and potato dextrose agar gave the best results. The two last-named were used in most of the experiments. Development was slow, the fungus forming on solid media pale pink, yeast-like colonies. The colonies consisted chiefly of budding conidia, irregular in shape and of variable size (2·4 by 3·6 to 6·3 by 8·6 μ), occasionally replaced by germ-tubes and short mycelia. Irregular, comparatively large, thick-walled cells (5·1 by 5·9 to 11·1 by 15·8 μ), to which the rôle of resting spores has been tentatively assigned, were also formed. It is not definitely known, however, whether such cells are more resistant to desiccation and extremes of temperature than the conidia. These cells, the contents of which are coarse, refractive, and oily, germinate by the rupture of the thick, outer wall and the emergence of a thin-walled cell, which may continue the process of budding. A well-developed mycelium was never formed.

The minimum temperature for the growth of the organism in culture was found to be below 10° C., the maximum between 26° and 30°, and the optimum 20° or lower. The thermal death-point of the fungus in culture was 46°, but the cultures were completely devitalized when kept for a few days at 30°.

Conidia from cultures proved highly resistant to desiccation, withstanding drying on cover-slips for 10½ months, and being viable, when thus dried out, after nearly 5 months' exposure to a temperature of 30°. The thermal death-point of conidia in dried films was 100°. It seems probable, therefore, that conidia derived from the budding of ascospores may be sufficiently resistant to adverse influences to survive and cause infection in the following spring.

The budding conidia of *E. deformans* were not found capable of causing alcoholic fermentation. The fungus grew at hydrogen-ion concentrations from less than P_H 3·3 to above P_H 9·75, with an optimum between P_H 4 and P_H 5. Grown in potato dextrose broth with P_H adjusted to various points between 5·1 and 9·8, *E. deformans* induced an increase of acidity in the medium. No change occurred in broth with an initial P_H of 3·9.

Negative results were obtained in attempts to isolate the fungus from washings of the surface of healthy peach twigs and buds

and from the soil beneath infested trees. A very few successful isolations were made from the interior of diseased leaves and stems, prior to the formation of asci.

Peach trees were successfully inoculated under favourable natural conditions with conidia of *E. deformans* from culture, the typical symptoms of curl being reproduced. It was impossible, however, to produce infection by the inoculation of very young seedlings grown from peach pits. The fungus was found to have sustained no loss of virulence after a year and ten months in culture.

FANT (G. W.). **The brown rot canker and twig blight of the Peach.**—*Forty-third Ann. Rept. New Jersey Agric. Exper. Stat. for the year ending June 30, 1922*, pp. 547–548, 1923. [Received 1924.]

Sclerotinia cinerea, the causal organism of blossom blight and twig canker of peach, was shown by cross-inoculation experiments to be responsible also for the brown rot of apple, plum, peach, and other fruit. Common methods of peach twig infection were found to be: (*a*) blossom infection in the spring, the fungus subsequently growing down through the pedicel into the twig; (*b*) invasion following injury to the host; (*c*) contact between infected fruit and adjacent twigs.

The spores of the fungus were found to remain viable throughout the winter on peach mummies; growth is renewed a week or more before the blossoming period of the fruit, with the result that numerous spores are ready to produce infection in the pink-bud stage.

The result of histological studies showed that the growth of the fungus is practically confined to the region just external to the cambium, i.e., the medullary rays between phloem units and the region forming the pericycle. The tissue-forming capacity of the cambium is commonly destroyed.

CIFERRI (R.). **Ancora sul marciume delle Mele Cotogne.** [Further notes on the rot of Quinces.]—*Riv. Pat. Veg.*, xiv, 5–6, pp. 77–92, 1924.

The determination of the fungus previously referred to *Penicillium crustaceum*, which the author has described as causing a rot of stored quinces in Italy [see this *Review*, ii, p. 167], has been revised by him from fresh cultures in accordance with Biourge's classification of the genus [see this *Review*, iii, p. 178].

The species belongs to the subgenus *Eu-Penicillium*, section *bulliardum*, of Biourge, and falls in the group having faintly defined concentric zones in culture and swollen supports below the basidia. As it does not agree with *P. griseo-fulvum*, the single fully described species in this group, a new species is created for it and named *P. malivorum*, a Latin diagnosis being given.

Other species of *Penicillium* were also isolated from the rotted fruit, but are regarded as secondary.

VASSILIEVSKY (N. J.). Черная пятнистость Крыжовника—**Alternaria grossulariae Jacz.** [Black spotting of Gooseberry—*Alternaria grossulariae* Jacz.]—*Болезни Растений* [*Plant diseases*], *Monitor Phytopath. Sect. Chief Bot. Gard. R.S.F.S.R.* xii, 1, pp. 4–7, 1923. [Received 1924.]

During the summer of 1922 the author observed in a garden in Leningrad a gooseberry disease caused by a fungus which is identified, in spite of the morphological differences mentioned below, as *Alternaria grossulariae* Jacz.

The first symptom of the disease appeared towards the end of June, in the form of dark brown or almost black shiny spots on the berries, young shoots, leaves, and petioles. On the berries the spots were usually regular in shape and in some cases extended almost over the whole surface. On the shoots the spots were elongated, but in the majority of cases they invaded the whole apical portion of the shoot, which dropped all its leaves and assumed a characteristic charred appearance. The leaves and petioles were less intensely attacked, the spots on the former developing usually along the margins. None of the spots bore fructifications of the fungus at this stage. Microscopical examination showed that the epidermal cells and several layers of those below were deformed and had turned a deep brown colour. In the tissues could be seen with difficulty a mycelium composed of thin, hyaline hyphae. On placing the infected organs in a moist chamber tufts of conidiophores bearing short chains appeared on them within forty-eight hours.

The examination of berries collected two weeks later showed that a corky tissue was formed under the attacked areas, while the epidermis and layers of infected cells pealed off. The slightly scabby spots then took on a greyish-brown tint. The berries bearing large spots developed a deep longitudinal fissure and fell off. On the shoots also the spots gradually assumed a lighter colour and became finally almost grey, often surrounded by a brown zone. At this stage dark tufts of conidiophores could be made out, even with the naked eye, on the spots both on the berries and on the shoots. As the latter dried up, the fungus in some cases advanced along them, but without fructifying. The conidiophores and spores agree in measurements and shape with Jaczewski's description, with the exception that the spores are somewhat thicker and their length is more variable (25 to 85 by 10 to 18 μ, usually 40 to 60 by 12 to 15 μ).

In culture on plum decoction agar an abundant aerial mycelium appears in a few days, at first white, then darkening, and finally of a dirty grey colour. The hyphae in culture vary greatly in thickness and in colour, from extremely thin and hyaline to comparatively thick (6 μ) and dirty brown. The dark-coloured hyphae bear at their apex short spore chains, not exceeding 3 spores. The latter differ somewhat from those produced in nature, in that the beak is sharply delimited from the body of the spore instead of being gradually narrowed, and in being smaller and darker.

Dried berries placed under moist conditions gave rise to a similar aerial mycelium. After such berries were kept in the moist chamber for a considerable time, numerous rounded sclerotia some-

what smaller than a millet grain, black outside and white inside, were formed on them. Attempts to follow up the further development of these sclerotia and their connexion with the *Alternaria* were unsuccessful.

One series of inoculation experiments, both by spraying gooseberry bushes of various ages with suspensions of spores and by inoculating healthy, nearly ripe berries with the spores by pricking, gave negative results. Although these experiments are inconclusive, they lead the author to agree with Jaczewski's opinion that the fungus is a facultative parasite, the more so as the gooseberry bushes, in the case observed by him, were neglected and badly overgrown with weeds. Its attacks, however, are not infrequent, as they have also been observed several times in the governments of Moscow and Koursk. The fungus is capable of causing appreciable losses, as in the present case over 60 per cent. of the berries were attacked; the chief damage, however, is done by the injury to the shoots, the tops of which are very often killed.

No control measures were tried, but according to Bondartzew's experience when treating gooseberry bushes badly attacked by American mildew [*Sphaerotheca mors-uvae*] and *Alternaria* in Koursk, copper sprays did not stop the development of the latter.

Vassilievsky (N. J.). О новом паразитном грибке—**Kabatiella ribis mihi**—на листьях Черной Смородины [A new fungus—*Kabatiella ribis* mihi—parasitic on Black Currant leaves.]—*Болезни Растений* [*Plant diseases*], *Monitor Phytopath. Sect. Chief Bot. Gard. R.S.F.S.R.*, xii, 1, pp. 9–10, 1923. [Received 1924.]

The disease briefly described in this note is characterized by the appearance on the leaves of the black currant of indistinct swellings which rapidly dry up and result in the formation of large, irregularly shaped spots. These are yellowish-brown on the upper side and dirty brown on the under side of the leaf. They usually extend over the whole of the apex of the leaf, sometimes advancing along the margins or deep into the lamina. In the middle of the leaf the spots occur but seldom and are much smaller and rounded in shape. Careful examination reveals the presence on the under side of the spots of minute, pale-coloured tufts of conidia, either grouped together or scattered, and a slight whitish bloom can be seen at the advancing margin. Under the microscope, hyaline, septate hyphae, 6 μ thick, can easily be made out in the attacked tissues. In places the hyphae become aggregated under the epidermis in a more or less dense weft, from which arises tufts of closely bunched conidiophores. Usually the tufts originate in the substomatal spaces, but the developing conidiophores rupture the epidermis, the divergent apices protruding to a short distance. The tips of the conidiophores are generally swollen, sometimes slightly bifid, and always bear very small, hardly noticeable sterigmata. In a few cases isolated conidiophores may show short, thick, sterile lateral branches. The conidiophores are 27 to 55 μ long and 16 to 8 μ thick, the apical swelling reaching a diameter of 11 μ.

From 4 to 9 conidia are abstricted from each conidiophore, the sterigmata on which they are borne only being visible after abstriction. The conidia are hyaline, unicellular, elliptical or cylindrical, rounded at both ends or pointed at their base, straight or slightly curved, and 6 to 15 by 2·5 to 6 μ, usually 8 to 10 by 3 to 4 μ in diameter. They germinate freely by budding, thus forming the above-mentioned whitish efflorescence on the under side of the spots.

The causal organism, a Latin diagnosis of which is given, is named by the author *Kabatiella ribis* nov. sp. It was found only on the branches most shaded from direct light of three black currant bushes in a garden in Leningrad, and careful observations failed to reveal any further progress of the infection. No control measures were therefore tried, and the author does not believe the fungus to be a dangerous parasite, although the leaves attacked by it died prematurely.

WORONICHIN (N. N.). Заметка о новом для Закавказья паразите культурной Земляники. [A note on a parasite of cultivated Strawberry new to Transcaucasia].—*Болезни Растений* [*Plant diseases*], *Monitor Phytopath. Sect. Chief Bot. Gard. R.S.F.S.R.*, xii, 1, pp. 10–11, 1923. [Received 1924.]

A brief description is given of an apparently widespread disease of cultivated strawberry which was found for the first time in western Georgia [Caucasus] by the author in 1920. Both by the outward symptoms it produces and by its morphology the causal fungus appears to agree fairly closely with *Phyllosticta grandimaculans* Bub. & Krieg. (*Ann. Mycol.*, x, p. 46, 1922), which was first recorded on cultivated strawberries at Königstein on the Elbe and is also stated to occur in Denmark. In the Caucasian form, however, the pycnidia are somewhat smaller and more elongated vertically, while the spores and sporophores are slightly more slender. The author does not consider these differences of specific value.

KLEBAHN (H.). **Fabraea fragariae, die Schlauchfruchtform der Marssonina fragariae.** [*Fabraea fragariae*, the ascigerous stage of *Marssonina fragariae*.]—*Ber. Deutsch. Bot. Gesellsch.*, xlii, 5, pp. 191–197, 1 fig., 1924.

In continuation of the author's previous researches (Haupt- und Nebenfruchtformen der Askomyceten, p. 288, 1918), on the strawberry fungus, *Marssonina fragariae*, the parasite was found on the leaf blades as well as on the petioles, its reddish-brown, irregular spots contrasting sharply with the familiar lesions with white centres produced by *Mycosphaerella fragariae*.

The ascigerous stage of *Marssonina fragariae* was found in 1919. Strawberry leaves showing both *Marssonina* and *Mycosphaerella* spots were laid out for overwintering in the autumn of 1918, and by the following May a few *Peziza*-like fruit bodies with bicellular spores, evidently a species of *Fabraea* and herein referred to as *F. fragariae*, had appeared on some of the leaves.

The fungus was isolated in pure culture from the ascospores in May 1919. The germination of the latter was by swollen germ-tubes which protruded both terminally and near the septum. The

mycelium extended slowly in rays, and remained sterile for 2 to 3 weeks, after which sessile conidia were formed in abundance, situated laterally on the hyphae, the terminal cells of which were abnormally thickened. The conidia, which were often arranged in small groups, were unmistakably those of *Marssonina fragariae* and measured 13 to 16 by 5·5 to 6·5 μ.

By January 1920 the agar cultures in test tubes had attained a diameter of only 0·5 cm., the original whitish tinge merging into brown in the slightly raised centre, where masses of conidia were exuded from minute spore bodies. The whole appearance of the cultures was strongly reminiscent of *Pseudopeziza* and *Entomopeziza* (*loc. cit.*, p. 317). When transferred to sterile strawberry leaves the cultures continued to develop numerous conidia.

Only a few apothecia developed on overwintered leaves with *Marssonina* spots in 1920 and 1921. Microtome sections through the minute, grey fructifications showed that, in the early stages, they are sub-spherical, 130 to 170 μ wide, and 120 to 150 μ high; subsequently they expand in the shape of a disc, attaining a width of 270 and a height of 150 μ and being joined to the leaf by a flat, somewhat depressed base. The tissue consists of three layers. The outermost, 25 to 40 μ in thickness, is formed by a coarse, brown-walled pseudoparenchyma with cells 6 to 11 μ in width. This almost entirely encloses the young spherical apothecia, causing them to resemble perithecia, while the older ones are surrounded by it up to the level of the surface of the disc. The second layer, with small cells, is thin-walled and light in colour, only 10 to 20 μ thick, and merges into a thin layer of paraphysis-like filaments—the hymenium. The asci are 48 to 54 μ long by 12 to 13 μ thick, elongated, oval, or clavate, with a blunt foot and the upper part drawn out in a short papilla. They contain eight bicellular spores, which are obliquely uniseriate or irregularly biseriate, oblong, slightly curved or somewhat asymmetrical, obtusely rounded at the ends, little or not at all constricted at the median septum, and measure in the ascus 16 to 18 by 4 to 4·5 μ, or when free 20 to 23 by 4 to 4·5 μ. The paraphyses, which project somewhat above the asci, are 3 to 4 μ thick, with clavate tips up to 5 μ in diameter.

The presence of conidia measuring 12 to 19 by 4·5 to 5·5 μ and exactly like those of the *Marssonina* stage was observed in crushed apothecia. They were situated terminally and laterally on filaments resembling paraphyses. Microtome sections through old, disc-shaped apothecia confirmed the formation of unmistakable *Marssonina* conidia in place of asci, which in some cases could only be discerned with difficulty. This remarkable association of conidia and asci in the same apothecia affords further convincing proof of the relationship of the two stages.

Besides the two fungi mentioned in the first paragraph, a second species of *Mycosphaerella*, *M. punctiformis*, which does not seem to have been previously recorded on strawberries, was found in considerable quantity on overwintered leaves. The ascospores of both the species of this genus on strawberries germinated readily and produced conidia within a week, in contrast to the slow growth of *Fabraea fragariae*.

[No reference is made to the recent work in Canada and the

United States on the allied leaf scorch disease of strawberries, see this *Review*, iii, p. 589.]

POEETZKY (V. S.). О новом нахождении сумчатой стадии **Sphaerotheca fuliginea (Schlecht.) Poll.** на Дыне. [A new record of the ascus stage of *Sphaerotheca fuliginea* (Schlecht.) Poll. on Melon.]—*Болезни Растений* [*Plant diseases*], *Monitor Phytopath. Sect. Chief Bot. Gard. R.S.F.S.R.*, xii, 3, pp. 86–88, 1923. [Received 1924.]

Amongst the collections made in 1916 by P. T. Nagorny in the Caucasus the author found a heavily mildewed specimen of melon (*Cucumis melo*) from the government of Tiflis. This bore perithecia in the mycelium on both surfaces of the leaves. The perithecia were found to agree with those of *Sphaerotheca fuliginea* [*S. humuli* var. *fuliginea*], the perfect stage of which has been occasionally recorded on various Cucurbitaceae, but not previously, as far as the author is aware, on the melon. The only difference noted was the slightly greater average size of the cells of the perithecia on the melon as compared with those on other allied plants.

The melon mildew is accordingly referred to *S. fuliginea* (Schlecht.) Poll. forma *cucurbitacearum* A. Pot.

KESSEL (H.). **Einiges über Schädlingsbekämpfung.** [Notes on pest control.]—*Deutsche Obst- und Gemüsebauzeit.*, lxx, 29, pp. 316–317, 1924.

During the spring of 1924 the writer made extensive tests in Brandenburg with various preparations for the control of fungous diseases and insect pests.

Apple scab (*Fusicladium* [*Venturia inaequalis*]) on the Winter Golden Pearmain variety was completely controlled by two applications of 1 per cent. solbar. There was no recurrence of the disease and the foliage was not injured.

American gooseberry mildew [*Sphaerotheca mors-uvae*] and other mildews yielded to treatment with cosan, which gives excellent control without any derangement of the physiological functions of the plants. Twenty gooseberry bushes were so heavily attacked by *S. mors-uvae* that it was thought impossible to save them, but several applications of 20 l. of cosan eliminated all trace of the disease.

Morello cherries infected by *Monilia* [*Sclerotinia cinerea*] since 1921 were sprayed in the winter with 5 per cent. solbar, a further application of the same preparation at 1 per cent. being given on the opening of the buds, and a final one when the leaves were fully open. After this treatment the disease occurred only in a sporadic form.

Fruit tree cankers were controlled by thorough excision of the diseased parts, followed by painting with carbolineum.

FANT (G. W.). **Spraying experiment for control of Pear leaf and fruit spot.**—*Forty-third Ann. Rept. New Jersey Agric. Exper. Stat. for the year ending June 30, 1922*, pp. 548–551, 1923. [Received 1924.]

The best control of pear leaf and fruit spot, caused by the

Entomosporium stage of *Fabraea maculata*, was obtained by seven applications, between the dormant period and 15th July 1921, of commercial lime-sulphur. The omission of any of the sprays (especially of that given on 16th May) weakened the efficacy of the treatment.

FANT (G. W.). **Spray versus dust in controlling the diseases of Apples.**—*Forty-third Ann. Rept. New Jersey Agric. Exper. Stat. for the year ending June 30, 1922*, pp. 551–553, 1923. [Received 1924.]

Equally satisfactory control of scab [*Venturia inaequalis*], black rust [*Physalospora cydoniae*], and brown rot [*Sclerotinia cinerea*] of Star, Delicious, King David, and Stayman apples was given in 1921 by seven applications (between the dormant period and 19th July) of commercial lime-sulphur (1 in 8 for early and 1 in 40 for later applications), or 80–10–10 atomic sulphur dust. Scab caused most damage on two dusted plots of Delicious (a particularly susceptible variety), but on the whole this disease was well held in check, contrary to a prevalent opinion, by dusting.

ADAMS (J. F.). **The casein spreader for orchard spraying.**—Reprinted from *Trans. Penin. Hort. Soc.*, 5 pp., 2 figs., 1924.

The use of calcium caseinate spreaders or fixatives is stated to have become very general in Delaware. Chemical analysis of three commercial casein-lime preparations has shown them to have a total casein content ranging from 22·6 to 25·56 per cent., the remainder being composed mainly of lime. During 1923 several calcium caseinate spreaders with a high casein content, ranging from 47·11 to 50 per cent., were tested in conjunction with lime-sulphur sprays, Bordeaux mixture, and the home-made dry-mix or wettable sulphur [see this *Review*, ii, p. 506]. In the lime-sulphur and Bordeaux sprays they were used at the rate of 8 oz. per tank of 200 galls. (i. e., 0·0315 per cent. as compared with 0·125 per cent. in the case of the commercial casein-lime spreaders mentioned above). The efficiency in distribution and adherence of the addition of this quantity of the preparations with a high basic content of casein is equivalent to that of 2 lb. of the commercial casein mixtures, while other advantages include immediate solubility, compatibility with all sprays, and economy.

Laboratory tests were made with spreaders consisting of soy-bean meal, or gluten, mixed with sal soda and water; soap bark (*Quillaja* bark); a soap manufactured by the E. I. du Pont de Nemours Co.; and Sunoco spraying oil. The first-named preparations increased the adhesiveness of the spray by 50 per cent. (soy-bean) and 60 per cent. (gluten) respectively, but they cannot be recommended on practical grounds. The others gave excellent results, Sunoco, however, being very expensive.

VOGT (E.). **Untersuchungen über den Schwefel.** [Investigations on sulphur.]—*Angew. Bot.*, vi, 2, pp. 276–300, 2 text figs., 1924.

No satisfactory hypothesis to account for the fungicidal action of sulphur is found in the literature of the subject and the author has therefore investigated, under more exact conditions than attempted

hitherto, the reaction of finely divided sulphur to air, light, and humidity.

The following preparations were used in the experiments: (1) 'sulphur depuratum lotum extrafein' (Riedel, Berlin), (2) ventilato sulphur (Teller, Magdeburg), (3) cosan colloidal sulphur (de Haën), (4) sulfoid colloidal sulphur (Schülke & Mayr, Hamburg), and (5) sulphur generated from the Rota generator [see this *Review*, i, p. 29] of Wolf, Netter & Jakobi, Bühl i. Baden. The substance was spread or sprayed over sheets of filter paper. The sulphur was washed before use to remove acid, and the colloidial preparations exposed for 24 hours to allow volatile substances to escape. With the Rota generator, paper was exposed to the sulphur stream $\frac{1}{2}$ m. away for 1 or 2 minutes and then to the atmosphere for 24 hours.

The sulphured paper was placed under a bell jar and air, previously freed from acids, was drawn over the paper and then passed through an absorption tube. Between the latter and the pump was a gas meter. In the first method N/10 KOH was used as the absorbent, and the acid produced by the oxidation of the sulphur determined by titration. In an improved method, hydrogen peroxide was used as the absorbent, and the oxidation products determined by titration with N/10 KOH.

The first series of experiments dealt with the formation of sulphur dioxide. Experiments 1–8 were carried out with the above materials, the temperature of the bell jar being 20–22° C. (except in 8, where it was 32°) and 2,000 l. of air was passed through the apparatus at the rate of 12 l. per hour. In experiment 9, cosan-treated strips were allowed to remain in the apparatus for 4 months before being tested. The final conclusion reached was that the amount of SO_2 given off from sulphur alone was negligible and within the experimental error.

The second series of experiments was similar to the first, but the bell jar was placed outside in the rays of the sun, the rest of the apparatus being protected. In experiment 10 with colloidal sulphur and experiment 11 with ventilato sulphur the amount of SO_2 produced was not increased. No oxidation of the sulphur appears to take place, therefore, under the influence of light and humidity.

In order to find out whether sulphur gives off H_2S the same apparatus was employed but lead arsenate was used as the absorbent. Experiment 13 with sulfoid colloidal sulphur lasted 46 days and experiment 14 with sulphur depuratum 5 months. There was no formation of H_2S under the action of light, air, and humidity.

The third section of the paper deals with the vaporization of sulphur. Fungicidal protection may be due to the fact that sulphur vaporizes and settles in a state of extremely fine division on the plants and fungal hyphae. The capacity of sulphur to vaporize was shown by placing a thin layer of sulphur at the bottom of a flask which was partially immersed in water at 50° C. In a few days the cool sides of the flask were covered with sulphur deposits. As sulphur vapour itself may have a toxic effect on fungous hyphae, the rapidity of vaporization was determined by means of an apparatus [which is described] in which a known

weight of sulphur was exposed to a temperature of about 55°, the atmosphere above being drawn away by an air pump. In experiment 15, not quite 0·1 per cent. of the sulphur was lost each day, after 11 months, and in experiment 16, using ventilato sulphur and no air current, 0·01 per cent. Both experiments indicated that the rate of vaporization of sulphur is very slow.

A bibliography of 27 titles is appended.

HÖSTERMANN (G.). **Eine bedenkliche Art der Verwendung von Schwefel als Pflanzenschutzmittel.** [A risky method of applying sulphur for the control of plant disease.]—*Gartenwelt*, xxviii, 18, pp. 183–184, 1 fig., 1924.

Attention is drawn to the injuries inflicted on greenhouse plants by the sulphur dioxide fumes generated by spreading sulphur dusts or pastes on the heating apparatus, whenever the temperature of the latter is allowed to exceed a certain limit. Low-pressure steam or warm-water heating is stated to be now in general use, but in a few cases where the old-fashioned high-pressure heating appliances are retained, serious damage has been observed on roses and other ornamental plants. The steam temperature of the low-pressure steam-heating apparatus averages 100° C. with a maximum of 106° (0·1 to 0·3 atmospheres), and that of the warm-water apparatus 90° to 100°. In both cases sulphur may safely be used for evaporation. With the high-pressure apparatus, however, the temperature may rise to 130° or even 180°. At 114·5° (between 1·5 and 2 atmospheres) sulphur melts into a thin, yellow liquid and oxidation in all probability begins at this point, increasing in intensity up to 260°.

Rose leaves in a greenhouse in which this method was employed showed greyish-brown, burnt areas, chiefly in the intervenal spaces. Tomato leaves were even more severely affected, the injured areas, however, being less sharply delimited. Greenhouse plants, by reason of their sheltered situation, have a much thinner protective layer of cutin than outdoor plants and are therefore more susceptible to noxious gases and the like.

PAPE (H.). **Ueber eine Blatterkrankung bei Primula obconica Hance.** [A leaf disease of *Primula obconica* Hance.]—*Angew. Bot.*, vi, 2, pp. 255–275, 2 pl., 2 figs., 1924.

During the winter of 1923–24 greenhouse plants of *Primula obconica*, affected by an obscure leaf disease, were submitted from two different nurseries for examination by the Biological Institute [Dahlem].

Yellow, yellowish-green, or whitish, sharply defined, irregular areas, 0·5 to 2 mm. in diameter, and somewhat depressed on the under side, appeared on the blades of the affected leaves, the veins and a strip round the edge generally remaining green. On older leaves the spots were light to dark brown, often surrounded by a darker ring. As a rule the spots were scattered at random over the surface, but occasionally the central portion of the leaf remained healthy and the diseased areas were regularly distributed near the margin.

Microscopic examination of the affected portions showed that in the case of the yellowish-green spots either the palisade or

mesophyll was affected, whereas both were dead in the portions underlying the yellow, white, or brown spots. The dead tissues were dry and shrivelled, often flattened, with the cell walls much distorted. There was no chlorophyll left in the cells, the lumina of which contained contracted, irregular, lumpy masses enclosing numerous polygonal flattened bodies the size of chloroplasts. The cell contents of the white, yellow, and yellowish-green spots were hyaline to pale grey, those of the brown spots pale to dark brown.

No trace of insect or fungous parasites could be detected, and experiments in the reproduction of the disease by exposing the plants to severe cold and by growing them in unsuitable soil (peat humus) gave negative results. On the other hand it was possible to reproduce the above symptoms by placing the plants under bell jars in which sulphurous acid gas was generated by the combustion of carbon disulphide with alcohol. The sulphuric acid content of the healthy leaves was 0·489 per cent. and that of the diseased 0·565 per cent. The disease appears, therefore, to be attributable to the emanation of sulphurous acid gas from the sulphur used on the heating apparatus in the greenhouses [see also preceding abstract].

KOTTE (W.). **Laboratoriumsversuche zur Chemotherapie der Peronosporakrankheit. I. Die Wirkung von Metallen und Salzen.** [Laboratory experiments on the chemotherapy of the *Peronospora* disease. I. The action of metals and salts.]—*Centralbl. für Bakt.*, Abt. 2, lxi, 11–18, pp. 367–378, 1924.

This work was carried out with the object of ascertaining the comparative values of various metals and salts in their action on *Peronospora* (*Plasmopara*) *viticola* and to determine the chemotherapeutical index [see this *Review*, ii, p. 554] of certain of the substances tested.

The methods adopted by the author are described in detail. The testing of toxicity cannot be carried out by hanging-drop cultures, as the quantities of toxic material and numbers of conidia must be standardized. This was shown by the action of copper sulphate on different suspensions of conidia. With 350 conidia in 1 c.c. of solution the conidia were killed in a concentration of 0·0012 per cent. of copper sulphate, whereas with 35 conidia in 1 c.c. solution the conidia were killed in a concentration of 0·000076 per cent.

Infected vine leaves were gathered at the oil spot stage, kept damp overnight to secure abundant sporulation, and the spores collected on a brush and placed in water. Two drops of this suspension were added to test tubes, each containing 1 c.c. of the liquid to be tested, controls in distilled water being also kept. The effects of the solution were examined after 3 to 6 hours, the figures after 6 hours, the critical time, being taken for the *dosis curativa* [see this *Review*, ii, pp. 551, 552]. Toxicity was gauged by the absence of motile zoospores, as it was considered immaterial whether the spores had failed to germinate or whether the escaped zoospores had been destroyed, the latter being much the rarer case. The test tubes were kept in the dark at 20° C. and shaken at intervals. For testing metals, 0·3 gm. of the powdered metal was placed in each test tube with 3 c.c. distilled water at 20°, the tubes

shaken every 15 minutes, and after an hour the water was filtered off, diluted in geometrical sequence with the quotient 2 and the fungicidal activity of the filtered water tested by sowing spores as before. The *dosis toxica* [see this *Review*, ii, pp. 551, 555] was estimated as the concentration at which all the epidermal cells of a tangential section from the upper side of a leaf of a Weisser-Gutedel vine were plasmolysed after immersion at 18° to 20° for 24 hours.

The action of metallic elements was first examined, the oxide and carbonate of copper being included for purposes of comparison. Mg, Zn, Al, Bi, W, Fe had no action, Hg and Sb were weak, Ni, Cd, and Pb somewhat stronger, whilst Cu and its above-mentioned compounds, with As, were the strongest.

Salts in the forms of nitrate, sulphate, or chloride of a number of metals were next tested. None of the salts used was much more active than copper sulphate, which was found to be effective at a concentration of 4·6 in 10,000,000 by weight. Equal to copper sulphate were nickel sulphate and mercuric chloride, next came uranyl nitrate and cadmium sulphate, the latter of which might be of some practical utility but is reported to cause damage to the vine. Zinc sulphate came next in fungicidal efficiency and was almost equalled by the sulphates of aluminium and cerium. Cobalt was not nearly so efficacious as nickel.

A great variety of copper compounds were then examined, but the toxicity of none of them was greater than that of the sulphate. The degree of electrolytic dissociation alone does not determine the degree of physiological efficacy.

For the examination of the toxicity of the acid radicles, compounds of sodium, potassium, and ammonium with various acid radicles were used, but the results were of no practical significance; the low values obtained for sodium fluoride and sodium salicylate were unexpected.

The *dosis toxica* (t) was then determined for a number of salts, the best results being given by aluminium sulphate ($> 13{\cdot}3$ per cent. by weight) and cerium sulphate ($> 1{\cdot}13$). The *dosis curativa* (c) for all the substances tested in the experiments had been already obtained in the manner described above and the calculation c/t which gives the chemotherapeutical index (θ) [the symbol ζ on the last line of p. 554 of vol. ii of this *Review* should read θ] is worked out by the author for several of the more important compounds. This was particularly favourable in the case of aluminium sulphate ($< 0{\cdot}000033$) and cerium sulphate ($< 0{\cdot}00030$). The cadmium sulphate index also appears favourable (0·0021) whilst those for iron sulphate (1·12) and cobalt sulphate (0.31), were unfavourable. Of the organic copper compounds none showed an index better than that of copper sulphate.

Sartory (A.) & Sartory (R.). **Sur le pouvoir antiseptique du bichromate de potasse et du bichromate de cuivre.** [On the antiseptic value of potassium bichromate and of copper bichromate.]—*Comptes Rendus Acad. des Sciences*, clxxviii, 15, pp. 1334–1337, 1924.

In a series of experiments [brief details of which are given], the

authors compared the fungicidal action of potassium bichromate and of copper bichromate on *Penicillium glaucum*, *Mucor racemosus*, *Rhizopus niger*, *Phycomyces splendens*, and *Sterigmatocystis nigra*. The results showed that in artificial culture a concentration of 1 gm. of potassium bichromate per litre considerably reduced but did not entirely inhibit the growth of the organisms tested, while all development was stopped by the same concentration of copper bichromate except in the case of *P. glaucum*, where there was a very feeble growth.

ESDORN (ILSE). **Die chemotherapeutische Prüfung der Beizmittel Kalimat und Fungolit.** [The chemotherapeutical estimation of the fungicides kalimat and fungolit.]—*Angew. Bot.*, vi, 2, pp. 105–112, 1924.

Experiments were conducted on the lines indicated by Gassner [see this *Review*, ii, p. 554] to test the chemotherapeutical efficiency in the control of bunt of wheat [*Tilletia tritici* and *T. levis*] of the fungicides kalimat and fungolit [see this *Review*, iii, p. 284].

The following biological values were obtained for kalimat: *dosis curativa* (c) 0·45 per cent.; *dosis toxica* (t) 0·32 per cent.; chemotherapeutical index (θ) 1·41; *dosis curativa* (cB) in sprinkling method 0·2 per cent.; sprinkling co-efficient (B) 0·44. In order to ascertain which of the components of kalimat, namely, formaldehyde and carbolic acid, constitutes the active principle, the biological values of these substances were determined. The values given by Gassner [*loc. cit.*] for formalin were based on the assumption that the solution tested by him contained 40 per cent. formaldehyde. It was subsequently found, however, to contain only 37·7 per cent., and the biological values must therefore be modified as follows: c, 0·122 per cent.; t, 0·1 per cent.; θ, 1·3; cB, 0·047 per cent.; B, 0·39. A comparison of the biological values of (*a*) kalimat containing 22·6 per cent. formaldehyde and (*b*) the same amount of formaldehyde in water gave the following results: (*a*) (as above); (*b*) c, 0·54 per cent.; t, 0·42 per cent.; θ, 1·3; cB, 0·21 per cent.; B, 0·39. It will be seen that the very slight differences in the biological values of these two solutions are completely negligible in practice, and the efficiency of kalimat may therefore be described as equivalent to that of a pure formaldehyde solution of the same concentration.

The biological values of phenol (stated to be present in kalimat to the extent of 30 per cent.) were ascertained to be as follows: c, 1·5 per cent.; t, 0·3 per cent.; θ, 5; cB, 1·5 per cent.; B, 1. The corresponding values of (*a*) kalimat containing 30 per cent. phenol and (*b*) a pure solution of 30 per cent. phenol were as follows: (*a*) (as above); (*b*) c, 4·0 per cent.; t, 1·0 per cent.; θ, 4·0; cB, 4·33 per cent.; B, 1·08. It is apparent, therefore, that phenol, with its unfavourable chemotherapeutical index, plays no part in the fungicidal efficiency of kalimat, which is based solely on its formaldehyde content. In any case, the amount of carbolic acid contained in the preparation is so small that there could be no question, at the prescribed concentration (0·5 per cent.), of any perceptible fungicidal action from it.

The mercury content of fungolit [Hohenheimer Beize] appears

to fluctuate, the sample used in these tests containing 10 per cent. Hg as compared with 7·7 per cent. in Gabel's determination [*loc. cit*]. The following biological values were obtained: c, 0·15 per cent.; t, 0·4 per cent.; θ, 0·38; cB, 0·3 per cent.; B, 2. These are very favourable figures and approximate to those obtained in previous investigations for uspulun and germisan. Gabel assumes that mercury is present either in the form of the chloride or cyanide. The latter, however, has quite different biological values, especially as regards its sprinkling coefficient, which is less than 0.2. Calculated by the same mercury content, fungolit is only about half as efficient as corrosive sublimate.

Lang-Hohenheim (W.). **Zur Kenntnis der Saatbeizmittel.** [The knowledge of seed disinfectants.]—*Angew. Bot.*, vi, 2, pp. 335–336, 1924.

Exception is taken to Gabel's assumption [see this *Review*, iii, p. 284, and preceding abstract] that the use of phenol in kalimat and that of ferric thiocyanate in fungolit (Hohenheimer Beize) fails to enhance the fungicidal properties of the formalin and mercury salts respectively in these preparations. The object of adding phenol to formaldehyde is said to be well known, while in the case of fungolit, the reduction of the mercury content from 0·085 per cent. (the amount present in a well-known fungicide containing 17 per cent. Hg and used at a strength of 0·5) to 0·02 per cent. (the amount present in fungolit used at a concentration of 0·25 per cent.) is extremely advantageous from the standpoint both of safety and economy.

Vogt (E.). **Methoden der Schädlingsbekämpfung. III.** [Methods of pest control. III.]—*Centralbl. für Bakt.*, Abt. 2, lxi, 11–18, pp. 323–356, 1924.

In continuation of his earlier work [see this *Review*, iii, p. 151], the author reviews the literature on various methods of soil disinfection for the control of insect and fungous pests.

The paper is divided into sections in which the principal experimental work on the subject is briefly summarized and discussed. The methods of soil disinfection designed primarily for the control of fungous diseases are enumerated under the heads of organic and inorganic chemical substances, and heat. The section on the effects of soil disinfection deals with the phenomenon of 'sick' soils, partial sterilization, increased yields, and their causes, while in conclusion the value of the various soil disinfectants is briefly discussed and methods of estimating it indicated.

A bibliography of 118 titles is appended.

Orton (C. R.). **Seed-borne parasites—a general consideration of the problem.**—*Science*, N.S., lix, 1538, pp. 539–546, 1924.

In an address delivered before the Canadian Branch of the American Phytopathological Society at Kingston, Ontario, on 20th December 1923, the problem of seed transmission of parasitic diseases of plants was considered under various aspects. Among the more important points of the discourse may be mentioned the citation of statistics of losses from disease in the principal crops of

the United States; the history of the dissemination of seed-borne parasites from 1730 onwards; the introduction and spread of foreign pathogenic organisms in America; importance of disease-free seed; nature, dissemination, and control of seed-borne parasites; seed production, testing, and disinfection; legal considerations in connexion with quarantine restrictions; and the need for co-operation in reducing the dangers from this source.

SIDERIS (C. P.). **An apparatus for the study of microorganisms in culture solutions under constant hydrogen-ion concentrations.**—*Science*, N.S., lx, 1540, pp. 17–19, 1 fig., 1924.

In order to obviate the necessity of discarding, after the first few examinations, the cultures used for the study of the change produced by micro-organisms in the hydrogen-ion concentration of the culture medium, the author devised an apparatus of very simple construction, by means of which the cultures can be examined and adjusting reagents can be introduced at frequent intervals under relatively sterile conditions.

The apparatus consists of an Erlenmeyer flask carefully plugged with cotton, through which are passed two glass tubes 5 mm. in diameter. One of these tubes provides for the introduction of the reagents (if desired, two tubes may be used instead, for introducing the acids and alkalies separately), and the other provides for the removal for examination of portions of the culture solution. The other part of the apparatus, which is detachable, is the receiver into which the solution is drawn for examination. This is made out of a test tube plugged with a rubber stopper, through which three glass tubes are passed, one connecting with the tube for withdrawing the solution, one to a suction apparatus, and the third for emptying the receiver. Details of the use of the apparatus are given.

QUANJER (H. M.). **Pflanzenpathologie auf anatomisch-physiologischer Grundlage.** [Plant pathology on an anatomical and physiological basis.]—*Angew. Bot.*, vi, 2, pp. 225–232, 1924.

The classification of plant diseases, as envisaged by various investigators, notably Appel and Westerdijk (*Zeitschr. für Pflanzenkrankh.*, xxix, p. 176, 1919) is briefly discussed and certain amendments proposed.

Silver leaf of plums (*Stereum* [*purpureum*]), for instance, is a disease which falls into none of the existing categories and must be regarded as a transitional type between a localized and general pathological condition. As it originates in the wood vessels, the disease should, strictly speaking, be classified in the vascular group, but this is unsuitable on account of the very noticeable external symptoms. It would, therefore, appear necessary to create a group for conditions of partially generalized debility.

In the group comprising conditions of completely generalized debility must be placed the so-called 'degeneration' diseases of the potato, namely, mosaic, leaf roll, and curl. Such anatomical symptoms as these diseases exhibit are localized in the phloem, and

the establishment in the Appel system of a sixth group, namely, diseases of the phloem, is proposed to contain these and similar cases.

The relations between animal and vegetable pathology are briefly discussed.

JOHNSON (J.) & MULVANIA (M.). **A new method of obtaining mosaic 'virus'.**—*Science*, N.S., lx, 1540, p. 19, 1924.

A brief description is given of a new method of obtaining 'virus' from mosaic-diseased plants with less admixture of foreign substances than possible by filtration of plant extracts through Pasteur or other similar filters. It is an application of a principle first described by de Bary and consists in placing the washed-out roots of the plants in a metal container attached to a city water supply so as to submit them to a pressure of about 100 lb., the stem of the plant passing through a split rubber stopper inserted in a 'packing box' similar to that used around valve stems. With a little experience it is quite easy to make this connexion water-tight around the stem. A succulent mosaic-diseased plant with hydathodes will readily yield considerable quantities of sap containing the infectious principle, though apparently the 'virus' thus obtained is not as concentrated as when secured from crushed tissue. By cutting the leaf or petioles so as to expose the ends of the vascular bundles, the liquid may be secured in a more concentrated form. It is important to use rapidly growing, succulent plants to obtain the best results. The sap as it comes out of the vascular system is usually free from contamination.

Virus obtained in this way probably closely approximates to that transmitted by sucking insects, and the method may, therefore, be useful for cross-inoculation studies.

ZELLER (S. M.). **Mosaic and other systemic diseases of Brambles in Oregon.**—*Oregon Agric. Exper. Stat. Circ.* 49, 15 pp., 8 figs., 1923. [Received 1924.]

A brief description is given of the symptoms produced by each of the three types of systemic diseases affecting brambles in Oregon, namely, mosaic, leaf curl, and bramble streak or eastern blue stem [see this *Review*, iii, p. 142]. Mosaic is the most widespread of these diseases, occurring on blackberries [*Rubus* spp.], red raspberries [*R. idaeus* var. *strigosus*], purple cane raspberries [*R. neglectus*], and black raspberries (*R.* [*occidentalis* var.] *leucodermis*), loganberries, thimbleberries (*R. parviflorus*), wineberries (*R. phoenicolasius*), evergreen blackberries (*R. laciniatus*), and dewberries (*R. macropetalus*). A list of susceptible varieties of raspberries and blackberries is given.

Leaf curl affects almost exclusively red raspberries, while bramble streak is confined to black raspberries.

No sign of *Aphis rubiphila*, the proved agent of mosaic transmission in the eastern States [see this *Review*, ii, p. 548], or of any other insect vector, has been observed in Oregon.

Control measures, based on the roguing of diseased plants and selection of clean nursery stock, are briefly indicated.

KLOTZ (L. J.). **Studies in the physiology of the fungi. XVI. Some aspects of nitrogen metabolism in fungi.**—*Ann. Missouri Bot. Gard.*, x, 4, pp. 299–368, 23 graphs, 1923. [Received 1924.]

A very detailed analysis of the work of previous investigators on the nitrogen metabolism of fungi is given.

Three fungi, *Aspergillus niger*, *Sphaeropsis malorum*, and *Diplodia natalensis*, were used in the investigations reported in the present paper. The organisms were grown on Duggar's solution, the nitrogen source being varied to give 5 different kinds of media. The solution consisted of the following pure chemicals per 50 ml.: dextrose 0·5 M solution, 25 ml.; KH_2PO_4 0·25 M solution, 10 ml.; $MgSO_4.7H_2O$ 0·1 M solution, 5 ml.; N source M solution, 10 ml. The N source was respectively KNO_3, NH_4NO_3, $(NH_4)_2SO_4$, peptone, and peptone with omission of the dextrose of the medium so that both C and N were supplied from the peptone. The technique of the experiments is described in considerable detail.

The organisms used in the experiments, together with *Nectria ipomoeae*, which was used in a preliminary test, were found to be unable to fix free nitrogen from the air.

After the essential nutrients are exhausted a decrease in dry weight of the fungous mat indicates the inception of autolysis, a formation of ammonia from the peptone and KNO_3 media occurring at the same time. Later autolysis leads to an increase, from a previous minimum, in the total nitrogen of the culture solution in all the media, and to the appearance of a trace of amino N in the three inorganic nitrogenous media. Autolysis in a species is proportional to the rate and amount of growth attained.

Ammonia was found to be the chief nitrogenous product of the splitting of the peptone of the media in the absence of another source of carbon. In the presence of dextrose, NH_3 was re-assimilated. The disappearance of carbohydrate from the medium synchronizes with the inception of autolysis.

In cultures in which the hydrogen-ion exponent becomes greater than P_H 7·0 there is a distinct loss of N which is due to the evolution of NH_3.

The causes of a slight fall in the P_H curves of the peptone minus dextrose cultures of *A. niger*, which appeared during the first 3 days of incubation, are not completely understood. Possibly during the rapid formation of protoplasm of the young mycelial hyphae the NH_2 group of the amphoteric amino-acids is slightly more utilized than the non-nitrogenous part, leaving an excess of some carboxyl groups. This different utilization by the rapidly growing young germ-tubes may possibly produce a brief state of hyperacidity before autolysis, respiration, and other processes making for alkalinity have come into full play. The alternating rise and fall in the *A. niger* series of KNO_3 is believed to be possibly due to similar causes. With *S. malorum* and *D. natalensis*, the mycelia of which were already mature, this temporary increase of acidity was not observed.

All three fungi increased the acidity of the $(NH_4)_2SO_4$ solution. The greatest hydrogen-ion concentration was produced by *A. niger*,

the maximum acidity (P_H 1·9) appearing in three days and subsequently dropping to P_H 2·3 to 2·4. The climax of acidity is due to the sulphuric acid freed from the $(NH_3)_2H_2SO_4$ plus the organic acids formed in the decomposition of the sugar, and the subsequent decline to consumption of the organic acids and also to autolytic processes. On NH_4NO_3 *A. niger* produces a hydrogen-ion concentration of P_H 1·6, the ammonia of $NH_3.HNO_3$ being consumed more rapidly than the nitrate ion.

Judging by the maximum dry weight obtained, peptone in the presence of dextrose was the best source of N in the media used. Nitrogen of the amino group was found to be readily assimilable by the fungi studied.

Some of the factors influencing the N content of the fungous mat include the N and C sources of the medium, length of incubation, rate of growth, and hydrogen-ion concentration.

The organisms displayed markedly divergent physiological relations, as indicated by their rates of growth and sugar consumption, their utilization and excretion of the several forms of nitrogen, and the varying nature and extent of the H-ion change of the medium.

A bibliography of 90 titles is appended.

BARNUM (C. C.). **The production of substances toxic to plants by Penicillium expansum Link.**—*Phytopath.*, xiv, 5, pp. 238–243, 2 figs., 1924.

The results of experiments, conducted on similar lines to those of Fahmy [see this *Review*, iii, p. 360] to investigate the production of toxins by *Penicillium expansum* indicated that a toxic principle, thermostable and non-volatile, is excreted into the culture solution upon which the fungus is grown. Cut stems of vetch (*Vicia gigantea*), mint (*Mentha* sp.), mallow (*Malva rotundifolia*), cauliflower, and lucerne were affected by definite symptoms of wilt when placed in culture solutions of the fungus, irrespective of whether the liquid was absorbed through the cut ends of the stem or through the roots of the growing plants, and in spite of the fact that there was no indication of interference with the water stream.

It is evident from these experiments that the production of a wilt-inducing principle in culture solutions is not restricted to plant pathogens, such as the wilt-inducing species of *Fusarium*, but may also be effected by a saprophyte like *Penicillium*.

SCHLUMBERGER (O.). **Ueber Temperatursteigungen bei lagernden Kartoffeln.** [On rises of temperature in stored Potatoes.]—*Angew. Bot.*, vi, 2, pp. 243–254, 5 graphs, 1924.

For several years the author has made a study of the temperature relations of healthy and diseased potatoes in storage. The experiments described in the present paper were directed to ascertain (*a*) the differences between the internal and external temperatures in healthy stored potatoes; and (*b*) the differences in temperature between healthy and diseased potatoes.

With regard to (*a*) it was found that the intensity of respiration

incidental to incipient germination produced only a negligible rise in temperature.

Differences in temperature between healthy potatoes and those inoculated with cultures of pathogenic bacteria were apparent in every case, though sometimes very slight. There was undoubtedly a correlation between the incidence of decay and the rise of temperature, but it is not known whether this is due to the increased intensity of respiration in the affected tubers or to that of the rapidly multiplying bacteria. Possibly the higher degree of humidity which stimulated germination in the diseased potatoes was also partially responsible for the rise of temperature. The development of the root system was markedly stronger in the diseased than in the healthy tubers.

In one series of tests on the Beseler variety the difference in temperature between healthy and diseased tubers amounted to 1·1° to 2°, while in another it averaged 4·4° C., the room temperatures being identical in each case (20°). During the first experiment, which lasted 3½ weeks, the number of diseased tubers in the inoculated series increased from 5 to 37 out of 90, the uninoculated controls remaining healthy. The figures for the second test, which lasted 2½ months, were similar, and the greater difference in temperature must therefore be ascribed to the more vigorous respiration of the germinating tubers. In a corresponding test in a cellar where the temperature ranged from 9·5° to 13°, the number of diseased tubers in the inoculated series rose from 25 to 38 out of 235 in 72 days, the 265 sound controls remaining healthy. The difference in temperature between healthy and diseased individuals in this case was only 1·2°.

The results of these experiments are regarded as decidedly indicating that the rises in temperature of stored potatoes are to some extent correlated with intensity of respiration and with the rapidity of spread of decay. The exact nature of the factors involved can only be determined by a detailed study of the different species of bacteria.

GARBOWSKI (L.). **Wpływ zaprawiana kłębów ziemniaczanych na plon.** [Influence on the yield of the treatment of Potato tubers with disinfectants.]—Reprinted from *Nowiny Rolniczy* [*Agricultural News*], i, 4, 4 pp., 1924.

Of the potato seed tuber disinfectants tested in the experimental fields of the Phytopathological Section of the State Agricultural Institute at Bydgoszcz [Poland] (on plots manured with stable manure and with a complete fertilizer respectively), formalin at a concentration of 0·1 per cent. was found to be the most satisfactory from the point of view of yield. The effect on the yield of each of the treatments employed was as follows, the control being taken as 100 : 0·1 per cent. formalin, in soil with complete fertilizers, 108, with stable manure, 99 ; 0·25 per cent. uspulun, 83 and 91 ; 0·01 to 0·2 per cent. sodium arsenate, 41 and 50 ; dusting with powdered sulphur, 91 and 74 ; and dusting with a mixture of superphosphate, potash, and sulphate of ammonia, 28 and 20.

ZIMMERMANN (H.). **Phytophthoraknollenfäule der Pflanzkartoffeln (Anbauversuch).** [*Phytophthora* tuber rot of seed Potatoes (cultivation experiment).]—*Angew. Bot.*, vi, 2, pp. 51–53, 1924.

An experiment was conducted at the Rostock [Mecklenburg] Agricultural Experiment Station to ascertain the effect of late blight (*Phytophthora infestans*) on the progeny of tubers from diseased plants.

Industrie tubers showing more or less pronounced symptoms of *Phytophthora* rot were planted during rainy weather on 4th May in medium soil receiving a fertilizer of ammonium chloride, basic slag, and potassium sulphate. There was no trace of *Phytophthora* in the resultant stand, both foliage and tubers being perfectly normal. This is in agreement with the results of earlier investigations on the transmission of late blight (*Mitt. Biol. Reichsanst.*, v, p. 4, 1907). A reduction was observed, however, both in the size and number of the tubers from seed potatoes affected by *P. infestans*, and the latter must therefore be regarded as inferior for planting purposes.

GOSS (R. W.). **Effect of environment on Potato degeneration diseases.**—*Nebraska Agric. Exper. Stat. Res. Bull.* 26, 40 pp., 3 graphs, 1924.

The results of recent extensive investigations in Nebraska in special experimental chambers, under controlled conditions of temperature, moisture, and sunlight, and also under field conditions, have shown that the symptoms of mosaic in the Bliss Triumph variety of potato are greatly influenced by environmental conditions.

Temperatures above 70° F. tend to decrease the incidence and severity of the symptoms, the visibility of which is increased below that point. Mottling was found to be the most constant symptom when temperature alone was varied; it disappeared under the combined influence of high temperature and intense sunlight. Wrinkling, curling, and rugosity were eliminated at the higher temperatures on mild mosaic plants. High soil moistures appear to favour the appearance of such leaf symptoms. High temperature was found to be a more important factor in masking mosaic symptoms than low moisture or increased sunlight, though under field conditions all three usually occur together.

The symptoms of mild mosaic [see this *Review*, ii, p. 548] reacted more rapidly to environmental conditions than the more severe types or the combinations of mosaic and spindle tuber used in the tests. The effects of the environment on the symptoms decreased with the increasing age of the plant.

Under field conditions mosaic was more severe with early and spindle tuber with late plantings. Short periods (4 to 8 days) of high temperature and increased sunlight were found sufficient to eliminate the leaf symptoms of mild mosaic and to decrease those of the more severe types. Under certain conditions the symptoms of mild mosaic may appear more serious than the symptoms of the severe types which develop under other, less favourable, conditions.

Spindle tuber and combinations of spindle tuber with mosaic result in a greater decrease in yield than mosaic alone. Mild mosaic does not seem greatly to reduce the yield in Nebraska.

In view of the data presented in this paper it is evident that errors in estimating the amount of mosaic in field crops are liable to arise unless the determinations are made under suitable conditions of environment, very young fields being avoided, and the date of planting taken into account. The same applies to attempts to eliminate the disease by roguing, and to the selection of healthy seed.

CHUNG (H. L.). **The Sweet Potato in Hawaii.**—*Hawaii Agric. Exper. Stat. Bull.* 50, 20 pp., 4 pl., 1923. [Received 1924.]

The following fungous diseases of the sweet potato (*Ipomoea batatas*), occurring in Hawaii, are briefly referred to on pp. 13–15 of this Bulletin. Black rot (*Sphaeronema fimbriatum*); stem rot (*Fusarium batatatis*); scurf (*Monilochaetes infuscans*); foot rot (*Plenodomus destruens*); blight or wilt (*Sclerotium rolfsii*); Texas root rot (*Ozonium omnivorum*); pit or pox (*Cystospora batata*) [but see above, p. 633]; soft rot and ring rot (*Rhizopus nigricans*); dry rot (*Diaporthe batatatis*); and Java root rot (*Diplodia tubericola*). The three last-named diseases, as well as *S. fimbriatum*, attack the crop in storage. There are also three foliage diseases of minor importance, namely, leaf blight [*Phyllosticta batata*], leaf spot [*Septoria bataticola*], and white rust [*Cystopus ipomoeae-panduranae*].

Control measures should be based on thorough sanitation and careful treatment with corrosive sublimate of all cuttings for planting taken from infected areas.

NIESCHULZ (O.). **Zur Morphologie der Kulturformen einer Herpetomonas aus Euphorbia cereiformis.** [On the morphology of the culture forms of a *Herpetomonas* from *Euphorbia cereiformis.*]—*Centralbl. für Bakt.*, Abt. 2, lxi, 11–18, pp. 311–316, 3 figs., 1924.

A study has been made, at the Utrecht Veterinary College, of a species of *Herpetomonas* isolated by Franchini from the latex of *Euphorbia cereiformis* at Bologna and presented to the author at the recent International Phytopathological Congress in Holland in the form of a sub-culture.

In fresh cultures the flagellates, which exhibited extraordinary motility, measured 8 to 10 by 0·5 μ and are therefore considerably smaller than the latex forms of *H. davidi*, given by Lafont as 18·5 by 1·6 μ and by França as 16·5 to 19·5 by 1·5 μ. The nucleus, which is situated towards the centre of the body, is generally round and contains a small caryosome. The round or rod-shaped blepharoplast is situated near the front, just behind the flagellum, which may attain a length of 20 μ.

The process of nuclear division [which is briefly described] is stated to correspond almost completely with that occurring in certain bird trypanosomes. The blepharoplast divides by amitosis, the new flagellum apparently arising from the daughter blepharoplasts. In the later stages of division the length of the flagellum

is much curtailed. The final stage of the reproduction of the organism is a division of the protoplasm to form two complete daughter flagellates.

The colonies showed flat compact growth, tending to fusion in the later stages, on blood agar plates.

The systematic position of the genus *Herpetomonas* (*Leptomonas*) is briefly discussed and the name *H. euphorbiae* proposed for the species under consideration.

THOMPSON (A.). **A preliminary note on a new bark disease of Hevea.**—*Malayan Agric. Journ.*, xii, 6–7, pp. 163–164, 1924.

In this brief note are recorded instances of definite parasitism observed at the end of 1923 in the case of an unnamed and undescribed fungus which was previously only known as a saprophyte on the renovating bark of *Hevea brasiliensis* at the corners of the tapping panels. One of the first symptoms of the new disease is the appearance of a small fan of mycelium, from $\frac{1}{4}$ to $\frac{1}{2}$ an inch in diameter, above the tapping cut. This develops into a small plate of white mycelium, with a mycelial fan at the edges. A number of such plates may coalesce to form patches from 6 to 8 inches in diameter, white at the edges and whitish-grey in the centre. In the majority of cases observed the fungus had penetrated to the wood and rotted the bark.

The disease is not as yet of importance, since only a few trees are attacked at a time. It was found to be amenable to treatment by putting the affected trees out of tapping, and painting them twice, at 7 days' interval, with a 10 to 15 per cent. solution of agrisol or brunolinum plantarium.

Scientific research notes.—*Bull. Rubber Growers' Assoc.*, vi, 5, pp. 321–323, 1924.

Among other matters of interest contained in recent reports submitted by the Scientific Staff of the Association may be mentioned the presence on tapped surfaces of rubber trees in Perak, Malaya, of two species of *Cyphella* or *Rhizoctonia*, the identity of which it is hoped to determine by laboratory investigations. The development of the fungi, which appear to produce symptoms resembling the mouldy rot due to *Sphaeronema*, was arrested by painting the affected areas with a mixture of tar and a suitable disinfectant.

PAINE (S. G.). **Spotted crepe Rubber.**—*Bull. Rubber Growers' Assoc.*, vi, 5, pp. 315–316, 1 pl., 1924.

Many attempts have been made by the author, hitherto with negative results, to infect rubber crepe with pure cultures of the bacterial organisms isolated from spotted crepe. The chromogenic bacteria *Bacillus prodigiosus*, *B. violaceus*, *B. pyocyaneus*, and *Sarcina aurantiaca* also failed to produce discoloration.

When spotted crepe is placed in humid conditions, *Penicillium*, *Aspergillus*, and other moulds, especially the first named, rapidly develop from the yellow areas. When the mould is transferred to a sound piece of crepe, the yellow stain is reproduced on the latter, and is succeeded by the formation of conidiophores with very dark

green conidia. The species of *Penicillium* producing these symptoms is believed to be the cause of the trouble, possibly acting in association with bacteria.

The hydrogen-ion concentration of the crepe is probably the factor which determines the nature of the parasite involved in the attacks. The growth of bacteria is usually restricted at P_H 5·5 and inhibited at 4·5, whereas fungi develop well in such acid conditions. The hydrogen-ion concentration of the unaffected crepe used in the above experiments was colorimetrically determined to be above P_H 5·5, and there was consequently little hope of successful inoculations with bacteria.

Ewert (R.). **Rauchkranke Böden.** [Smoke-diseased soils.]—*Angew. Bot.*, vi, 2, pp. 97–104, 1924.

In 1919 the writer inspected the condition of the vegetation in an area immediately adjacent to a large zinc foundry in Upper Silesia. Trees, as well as cereal and vegetable crops, were severely affected by the typical injuries due to sulphurous acid poisoning, and Leguminosae could not be induced to grow at all. Six samples of the soil (a medium clay) from the affected area were removed to the Proskau Agricultural Experimental Station and subjected to chemical analysis. All were found to have a very low lime content, the lowest being 0·168 and the highest 0·657 per cent. of the air-dry soil. There was a relatively high zinc content (lowest 0·180 and highest 0·587 per cent.) but according to Baumann (*Landw. Versuchsstat.*, xxxi, p. 1, 1884), the adsorptive capacity of clay soils is sufficient to counteract the injurious effect of zinc. None of the soils gave an acid reaction with the litmus test.

The addition of 2 per cent. lime greatly improved the condition of the soil and acted favourably on all the plants tested except lupins. In the smoke-diseased soils the nodules were frequently absent from the roots of Leguminosae and even the application of lime failed, as a rule, to result in any notable improvement in this respect.

Clausen. **'Dörrfleckenkrankheit' oder 'moorkoloniale' Krankheit?** ['Grey speck' or 'moorkoloniale' disease?]—*Deutsche landw. Presse*, li, 22, p. 253, 1924.

The term 'grey speck disease' is held to be more expressive of the symptoms of this affection as they occur under German conditions than the term 'moorkoloniale' [Dutch 'veenkoloniale'] disease advocated by Hudig [see this *Review*, iii, p. 605]. A distinction should be made between 'grey speck' and 'yellow tip' [see this *Review*, i, p. 209], and the latter apparently requires somewhat different treatment.

Waksman (S. A.) & Starkey (R. L.). **Influence of organic matter upon the development of fungi, actinomycetes and bacteria in the soil.**—*Soil Science*, xvii, 5, pp. 373–378, 1924.

In continuation of their previous experiments [see this *Review*, iii, pp. 175, 362] the authors made observations on the effects pro-

duced by the addition to the soil of organic materials of varying nitrogen content.

It was found that certain substances stimulated the development of one particular group of micro-organisms while producing little effect on the others. Thus dextrose (0·5 per cent.) increased the number of bacteria plus actinomycetes in a very marked degree, especially on a very fertile soil treated with stable manure, lime, and potassium salt and phosphate, where the figure rose from 9,360,000 to 103,000,000 in two days. Cellulose effected a great increase in the number of fungi in 17 days, particularly on untreated soil and on one receiving stable manure and potassium. The stimulatory effect was augmented by the addition of $NaNO_3$. Rye straw (0·7 per cent. nitrogen) and lucerne meal (2·5 per cent. nitrogen) added in the proportion of 0·5 per cent., produced a large increase in fungi and bacteria in 14 days, particularly the lucerne meal. Additions of $NaNO_3$ to the straw-treated soil further increased the numbers of fungi without affecting the bacteria, but a similar addition to the lucerne meal-treated soil did not influence the numbers either of fungi or bacteria. All the groups were stimulated by the addition of 1 per cent. of dried blood (9·5 per cent. nitrogen) which brought about an entirely different development of micro-organisms than did substances poor in protein.

The increase in the numbers of fungi was more striking in acid than in approximately neutral soils, while in general the micro-organisms developed more abundantly in fertile than in comparatively poor soils.

LEE (H. A.) & JENNINGS (W. C.). **Bacterial red stripe disease of Tip Canes.**—*Hawaiian Sugar Planters' Assoc. Circ.* 42, 4 pp., 3 pl. (1 col.), 1924.

A new disease of Yellow Tip, Red Tip, and Striped Tip sugar-canes has made its appearance in the Kohala district of Hawaii, where the anticipated losses are estimated at 1 to 5 per cent. of the production per acre.

Young canes from 6 inches to 3 feet in height are most affected, being conspicuously marked by long, narrow, dark red, longitudinal streaks on the leaves, which usually start midway between the tip of the leaf and its juncture with the sheath. The first indication of the disease is a watery, dark green streak spreading up and down the leaf and gradually turning bright red. The streaks, which measure ½ to 1 mm. in width and sometimes coalesce to form a broad band, commonly appear first near the mid-rib and are followed by others farther out. The lower side of the mid-rib also frequently shows streaks, the upper side and the leaf margins being seldom affected. Only in very severe cases do the streaks run down into the leaf sheaths.

Middle-aged leaves are more frequently affected than either young or old ones. The occasional infection of young central leaves often results in top rot of the cane and probably causes a deterioration in the quality of the juice. Young cane shoots shaded by older canes are very liable to infection and frequently die out entirely. The disease is particularly severe in ratoons on young, actively developing, vigorous leaf tissue.

Besides the varieties mentioned above, a number of native canes are seriously affected. H 109 appears to be completely immune, while D 1135, Yellow Caledonia, and Badila show a high degree of resistance. Definite stripe lesions, however, have been observed on D 1135 and Yellow Caledonia, cuttings of which, although themselves resistant, may serve to transport the disease to healthy districts.

Microscopic observation reveals the presence of masses of bacteria in the reddish-brown cells with thickened walls which underly the affected areas. Motile bacteria have also been observed in apparently normal tracheal vessels and cells of the bundle sheath adjacent to the diseased portions.

Preliminary inoculation experiments with the bacteria isolated from infected tissue gave positive results, uninoculated controls remaining healthy.

It has frequently been observed that red stripe disease is slightly more general on the windward side of the field, while a moist, dripping condition in the plantations also probably favours the spread of infection. Chewing insects appear to be attracted to the water-soaked stripes, and doubtless contribute to the dissemination of the disease. Evidence is available which indicates that infection is occasionally transmitted by cuttings.

Stringent precautions, including the disinfection of implements used in the infected area and of the clothes of workers employed there, are urged in order to exclude the disease from districts which are still healthy. No cuttings of cane or related grasses (e.g., sorghum, maize, elephant grass [*Pennisetum purpureum*], Sudan grass [*Andropogon sorghum sudanense*], and broom corn [*A. sorghum*], should be transferred from Kohala to healthy districts, and a quarantine enacted by the Board of Agriculture and Forestry of the Territorial Government penalizes any infringement of this regulation with a fine of $500. Other control measures recommended include early planting and harvesting, and timely applications of nitrogenous fertilizers. The ultimate control of the disease will probably be secured by the gradual substitution of resistant for susceptible varieties. There is reason to believe that certain Kohala seedling varieties of Tip and D 1135 parentage, which thrive at high elevations, are resistant.

KUYPER (J.). **Het optreden van strepenziekte in den westmoesson van 1923–1924.** [The occurrence of stripe disease in the west monsoon of 1923–1924.]—*Meded. Proefstat. Java Suikerind.*, 5, pp. 141–150, 1 graph, 1924.

The heavy infection of sugar-cane by mosaic disease in nearly all parts of Java in January and February 1924 led to an investigation of the causes underlying these sudden outbreaks which are becoming a matter of common experience.

As usual, the first cutting, harvested in December, was almost free from infection, but by the first half of February almost the whole of the second cutting was diseased. In the plantations under the author's own charge the work of roguing out the infected individuals reached a climax during the period 20th February to 1st March. In one of the plots where the maximum infection

occurred about 10th March the grass *Cyperus rotundus*, which is stated to be avoided by aphids, grew abundantly, *Panicum colonum* [see this *Review*, ii, p. 236] also being present to a lesser extent. *Aphis maidis* only occurred in small numbers.

A distinct correlation was noticed between the date of planting and the incidence of the disease, cane planted before 15th November being much healthier than that planted later. A remarkable feature of the 1924 epidemic was the attack on normally resistant or immune varieties, e.g. different selections of POJ. In certain cases it was possible to arrest the progress of the disease in resistant varieties by the excision of the affected parts. This method cannot, however, be recommended for use on a large scale.

It was further observed that the disease occurred indiscriminately on isolated plants and on those adjacent to infected areas. This and other considerations are regarded as indicating that other agencies besides that of insect transmission may be at work in the spread of mosaic disease.

JOHNSTON (J. R.). **The mosaic disease of Sugar Cane.**—*Louisiana Planter*, lxxiii, 1, pp. 10–11; 2, pp. 30–32; and 3, pp. 49–52, 1 fig., 1924.

This paper presents a concise survey, based on the author's own investigations as well as on those of other workers, of the actual situation in regard to the prevalence, distribution, and etiology of mosaic disease of sugar-cane. The symptoms of the disease are briefly described, with notes on its relation to soil fertilization, on its transmission, and on the available figures of the losses caused by it in the various countries affected.

A bibliography of over 100 titles is appended.

Mosaic disease in Natal. Important communications from world's experts.—*S. African Sugar Journ.*, viii, 4, pp. 269–271, 1924.

The following communications have been received in answer to a memorandum of 1st November 1923 relative to the measures proposed by the Government Mycologist, Natal, Mr. H. H. Storey, for the eradication of mosaic disease of sugar-cane [see this *Review*, iii, p. 237].

Dr. Tempany, Director of Agriculture, Mauritius, drew attention to the possibility of the apparently immune Uba variety harbouring the disease without showing any of its effects, and to the risk of transmission by susceptible grasses.

Dr. F. S. Earle, Director of Agriculture, General Sugar Company, Havana, Cuba, expressed his complete agreement with Mr. Storey's views. In his opinion no serious practical effects need be anticipated from grass transmission, the risks of which are stated to be negligible where the proper methods of mosaic eradication are intelligently applied.

Dr. E. W. Brandes, of the United States Department of Agriculture, doubts the wisdom of cultivating only one variety (Uba) in Natal and advises eradication of the disease by the effective (though extremely costly) methods employed in Java and Formosa, namely,

roguing out the infected plants in seed gardens at high altitudes and sending only healthy plants to the gardens at lower elevations. This process is continued until the plantation level is reached and seed is furnished for the growing of plantation cane [see this *Review*, i, p. 187 ; ii, p. 237].

The risk of transmission by wild grasses is considered by Dr. Brandes to be slight, judging by conditions in Florida, where no evidence has been obtained of the survival of mosaic during the dormant period in any of the wild hosts studied. He has never observed mosaic in any grass more than three-quarters of a mile from infected cane.

Attention is drawn to the gravity of the situation in regard to mosaic disease, an epidemic of which is believed to be impending in Cuba. The disease is stated to be almost invariably allowed to take its course until it is beyond control, with the notable exception of Florida, where all diseased and all healthy cane within a half-mile radius of the infected area was destroyed in 1920 with excellent results.

Mosaic disease eradication campaign.—*S. African Sugar Journ.*, viii, 7, pp. 523–524, 1924.

In view of the gravity of the mosaic disease situation in Natal [see this *Review*, iii, p. 237] the South African Government purposes to issue a proclamation rendering illegal the cultivation of non-Uba canes until all trace of infection is exterminated. This step can only be taken, however, if European growers are prepared to waive all claims to compensation, which will not be admitted except in the case of Indian and native growers of chewing canes. The views of representatives of the former class on the matter of compensation are to be ascertained by the Council of the South African Sugar Association.

Storey (H. H.). **The transmission of a new plant virus disease by insects.**—*Nature*, cxiv, 2859, p. 245, 1924.

In a paper read before the Imperial Botanical Conference in London [in July 1924] the author described [under the name of 'streak'] a variegated condition of a number of Gramineae, characterized by chlorosis of the leaves in narrow, broken stripes parallel to the veins and by a reduction in the vigour of the plant. In maize this condition has long been recognized as a factor limiting production in the coastal and midland areas of Natal. Similar phenomena occur in sugar-cane and a number of grasses.

Evidence is adduced in the above-mentioned paper for the view that this variegated condition is a disease akin to, but not identical with, the well-known mosaic of sugar-cane, maize, and other Gramineae. Recent work on insect transmission has afforded confirmation of these conclusions.

In a series of carefully controlled experiments the author claims to have demonstrated the ability of the adults of a Jassid leaf-hopper (an undescribed species of the genus *Balclutha*) to transmit the disease from infected to healthy plants. Insects taken from healthy plants failed to produce the symptoms, and none of the controls developed the disease. All attempts to secure infection by

means of the agency of *Aphis maidis,* the vector of the common grass mosaic in Natal as elsewhere, gave negative results.

Only a proportion of the leafhoppers collected in diseased maize fields proved capable of producing the disease, but no individuals once shown to be vectors failed to transmit the virus to all the plants on which they were placed.

Preliminary attempts to secure transmission of infection from maize to sugar-cane and grasses have not been successful, but field observations and the similarity of symptoms suggest that a single disease is affecting the various hosts.

Storey (H. H.). **The influence of streak disease upon the yield of Uba Cane.**—*S. African Sugar Journ.*, viii, 7, pp. 519–522, 1 fig., 1924.

The results of an experiment in which setts of healthy and streak-diseased Uba cane [see preceding abstract] were grown under identical conditions showed a most striking difference in the stands produced by the two series of plots. No single plot of streaked cane approached in general vigour of growth any healthy plot. The probable loss in the streaked plots is estimated at 30 to 50 per cent. The writer is satisfied that streak disease is not merely a concomitant of the prevalent spell of drought, though it is likely to prove more severe under such conditions.

Control measures, based on roguing and the use of healthy seed cane, are briefly indicated.

Dormer (W. C.). **Sugar pests and diseases in the Mackay district.**—*Queensland Agric. Journ.*, xxi, 5, pp. 363–368, 1924.

The following diseases of sugar-cane have been observed in various localities of the Mackay district of Queensland.

'Knife cut', an obscure disturbance characterized by wounds all on the same side of affected canes and capable of inflicting very severe damage to the crop both in tonnage and sugar content, was very prevalent on D 1135 throughout the districts visited. The disease does not appear to be transmitted by the seed or disseminated by insects.

Mosaic was observed on the variety M 168/04, affected stools of which were at least 18 to 24 inches shorter than healthy individuals. HQ 426 and M 1900 Seedling, growing in close proximity to the diseased plots, did not become infected, and only one stool of 7 R 428 developed the symptoms. A list of the sap-sucking insects found in the infected fields is given; *Aphis maidis* is not included. In another locality mosaic was noticed on the D 1457 and 9813 varieties.

'Bleeding' after cutting, to which no cause can be assigned, was responsible for the death of ratoons of the HQ 426 and D 1135 varieties.

Leaf stripe disease (*Sclerospora sacchari*) was observed on a few stools of the D 1457 variety.

'Bunchy top', in which the growing cane leaves are crumpled and twisted about the heart, caused a temporary arrest of growth in 1900 Seedling, Q 813, and other varieties. After a time the

curled leaves die and the cane appears to recover. Possibly this affection is due to the rapid growth of the cane after a sudden break in the drought.

LIND (J.). **Fungi collected on the north coast of Greenland by the late Dr. Th. Wulff.**—*Meddelelser om Grønland*, lxiv, pp. 291–302, 1 pl., 1924.

Considerable interest is stated to attach to the material collected by the late Dr. Wulff on his expedition to the north coast of Greenland during 1916 to 1918, in view of the fact that this region lies nearer the Pole than any other explored for botanical purposes. Only one true parasite occurs among the 45 fungi represented in the collection, and enumerated in the present paper, namely, *Melampsora parasitica* on *Saxifraga oppositifolia* (*Caeoma* stage) and *Salix arctica* × *glauca*. The Arctic species are stated to be far more plurivorous than the southern or even than the same species occurring in southern localities. *Mycosphaerella tassiana*, for instance, has been recorded on over 100 hosts, and in the present collection is represented on 43, including monocotyledons, dicotyledons, and pteridophytes.

GONZÁLEZ FRAGOSO (R.). **Flora Iberica. Uredales (royas de los vegetales). T. I. Género Puccinia.** [Flora of the Iberian Peninsula. Uredinaceae (rusts of plants). Vol. I. Genus *Puccinia*.]—lxxi + 416 pp., 208 figs., Madrid, Mus. Nac. de Cien. Nat., 1924.

In this important work all the species of *Puccinia* are described [in Spanish] which have already been recorded for the Iberian Peninsula, or which, from the occurrence of their host plants, may reasonably be expected to occur there. The species are arranged according to the families of the host plants, and bibliographical citations, lists of synonyms, and a statement of the geographical distribution, as far as is known, are included. The work closes with separate indices for the fungi and the hosts both under their scientific and popular names. The author is responsible for twelve new species of the genus and four new forms.

HÖHNEL (F. v.). **Beitrag zur Kenntnis der Gattung Cylindrosporium Grev.** [Contribution to knowledge of the genus *Cylindrosporium* Grev.]—*Ann. Mycol.*, xxii, 1–2, pp. 191–203, 1924.

Thirty-three species of the genus *Cylindrosporium* are discussed and referred to eleven genera, five of the latter being new. The author considers that Saccardo's conception of this genus is not that of Greville, who founded the genus on *C. concentricum*, a fungus that does not seem to have been encountered subsequently and remains the only true species of *Cylindrosporium*. Saccardo's conception covered two heterogeneous elements, a sub-epidermal Melanconiaceous genus which the author refers to *Phloeospora* Wallr. (= *Phleospora* Sacc. = *Septogloeum* Sacc. = *Cylindrosporium* Sacc. (non Grev.) p.p.) and the conidial stage of various species of *Entyloma*, which, together with conidial forms of certain species of *Doassansia*, he puts in a new genus *Entylomella* (= *Cylindro-*

sporium Sacc. (non Grev.) p.p.) belonging to the Hyphomycetes and close to *Cercosporella*.

A few of the species dealt with occur on plants of economic importance. *Cylindrosporium brassicae* Fautr. & Roum., on swedes and rape, is a *Cercosporella*, and apparently, from the descriptions, is the same as *Cercosporella albomaculans* E. & E. and *Ramularia rapae* Pim. *Cylindrosporium padi* Karst. (= *C. tubeufianum* Allesch.) on cherry, plum, &c., should be called *Septoria padi* (Lib.) Thüm. since it is the same as *Ascochyta padi* Libert and is a *Septoria*. *Cylindrosporium pruni* (Syd.) Diedicke on *Prunus japonica* should be called *Septoria pruni* (Syd.) v. H. comb. nov.

The imperfect form of *Apiognomonia erythrostoma* (Fckl) v. H. on cherry leaves forms the type species of a new genus, as *Libertina stipata* (Lib.). This genus resembles *Libertella* in the character of its pycnidial walls and in the shape of the conidia, but the conidiophores ramify into long and often parallel branches which bear the conidia at the apex and on the side. *Cylindrosporium humuli* on hop leaves is a small *Phloeospora*.

MORSTATT (H.). **Der Pflanzenschutzdienst in Brasilien.** [The plant protection service in Brazil.]—*Nachrichtenbl. deutsch. Pflanzenschutzdienst.*, iv, 5, p. 34, 1924.

The Plant Protection Institute of Rio de Janeiro (Instituto Biologico de Defesa Agricola), founded by Presidential Decree in 1920, comprises six departments, dealing respectively with phytopathology, agricultural entomology, plant breeding, plant inspection service, soil biology, and field experiments.

The functions of the Plant Protection Service, defined by Presidential Decree in 1921 and here briefly summarized, are based on those in force in the similar services of other countries.

Modification of nursery stock, plant, and seed quarantine regulations. Amendment No. 1 of revised rules and regulations supplemental to notice of quarantine No. 37.—*U.S. Dept. of Agric. Fed. Hort. Board Leaflet*, 2 pp., 1924.

Regulation No. 15 of the revised rules and regulations supplemental to notice of quarantine No. 37, governing the importation of nursery stock, plants, and seeds into the United States, which came into effect on 5th April 1923, is amended as from 1st July 1924, as follows. The importation from countries contiguous to the United States of any class of nursery stock, &c., the entry of which is not provided for under regulations 2 and 3 and which is not regarded as being attended by serious risks to the agriculture or horticulture of the United States may be authorized under the proper safeguards and with the following provisions. Importations under this regulation shall be limited to specific classes of nursery material which may be considered as peculiar to, or standard productions of, such contiguous countries. A certificate of a duly authorized official of the country of origin, vouching for the production in that country of the material proposed for export, must accompany the covering invoice. Cut flowers from the Dominion of Canada may be imported without restriction into the United States when free from sand, soil, or earth.

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Spegazzini (C.). **Revisión de las Meliolas argentinas.** [Revision of the species of *Meliola* in the Argentine.]—*Ann. Mus. Nac. Hist. Nat. de Buenos Aires,* xxxii, pp. 389–393, 1924.

This revised list of the species of *Meliola* in the Argentine Republic contains 58 species, of which 17 and 3 varieties are new to science. Beeli's formula [*Bull. Jard. Bot. de l'Etat, Bruxelles,* vii, 1, p. 91, 1920] is used for the characters, and in addition detailed notes on the morphology and relationships of each form are given. A key for the rapid determination of the species is prefixed, and an index of hosts and fungi is appended.

Pater (B.). **Eine Beobachtung am Eichenmehltau, Microsphaera quercina Burrill.** [An observation relating to Oak mildew, *Microsphaera quercina* Burrill.]—*Buletinul de Informatii,* [Cluj], iv, 1, pp. 25–26, 1924.

In the forests around Cluj in Rumania oak mildew was recorded by the author for the first time in 1910. From that year to 1915 severe infection was found on the leaves of young shoots arising from the stumps of felled oaks; in 1915, a year which was very favourable to the development of the fungus, it was also observed for the first time on the leaves of adult trees, both in the forests and in the Arboretum of the Agricultural Academy, where it caused a heavy infection of the leaves of *Quercus pedunculata* and *Q. sessiflora,* while a *Q. cerris* tree standing in close proximity to the two others remained immune. In spite of careful search no perithecia of the fungus were found until 1922, when they were discovered by T. Grintescu. On the ground of these observations, which confirm those made in western Europe, the author believes that *Microsphaera quercina* has been disseminated from the west towards the east, and that after its introduction into a new territory it requires a period of several years to become acclimatized and to be able to go through the whole cycle of its life-history.

SIEMASZKO (W.). **Pleśń liściowa, Monilia foliicola Woronichin, w świetle spostrzeżeń i badań biologicznych.** [The leaf blight, *Monilia foliicola* Woronichin, in the light of biological observations and investigations.]—Reprinted from *Acta Soc. Bot. Poloniae*, ii, 2, 18 pp., 1 pl., 1924. [English summary.]

This paper describes the morphology and biology of *Monilia foliicola*, first collected by Woronichin on the Caucasian coast of the Black Sea [*Moniteur Jard. Bot. Tiflis*, xxviii, p. 24, 11 figs., 1914], where it causes blight of the leaves of the Circassian strain of pear (*Pyrus communis*) escaped from cultivation, and also of *Mespilus germanica*. The author found this species in 1915 and 1917 at various points in the submontane zone of the same coast between 500 and 700 m. altitude, on the Circassian pear, wild hazel-nut (*Corylus avellana*), and alder (*Alnus glutinosa*), and also in 1922 on the latter host growing in marshes in Poland in the virgin forest of Bialoweska Puszcza. All observations tend to show that the fungus requires very moist conditions for its dissemination, and that like *Botrytis cinerea* it can be transmitted under favourable conditions from one host to another by direct contact of the infected leaves with healthy ones. The fungus was never met with on European varieties on pear or on the cultivated hazel-nut on the Black Sea coast.

In nature the fungus only infects the leaves, which are killed prematurely and on which appear irregularly shaped, brownish, yellowish-grey, or white spots, sometimes surrounded by a brown margin, and up to 1 or 2 cm. in diameter. In its further development, especially on pear leaves, it forms indistinct concentric rings around the primary spots, sometimes separated from each other by brownish zones. In some cases the spots may coalesce, finally spreading over most of the surface of the leaf.

Clusters of a downy mildew, at first white and later ochre-coloured, are visible on the upper, or less often (in the alder) on the under, surface of the spots. Like *Moniliopsis aderholdi* Ruhland, the fungus forms *Monilia*-like chains of microconidia (pseudoconidia) acropetally; these have not been seen to break up into separate spores. In nature the fungus is generally sterile, microconidial chains having been only once observed by the author, on alder leaves in Poland.

In pure cultures the microconidia are formed in about 10 to 14 days. They do not germinate at room temperature, but after exposure to winter conditions germination was obtained. Sterile clusters of mycelium, which the author regards as pseudosclerotia, can germinate when entire, but not when cut into pieces; on dried herbarium material they retained their viability for seven months.

Infection experiments on leaves of *Corylus*, *Alnus*, apple, and pear, with mycelium from Polish material, showed that the fungus develops best on leaves of *Corylus* and *Alnus*. The spots on the leaves appeared in two days and the typical clusters of hyphae a week after inoculation, but no microconidia were formed even on leaves destroyed by the fungus. When leaves of *Alnus* were inoculated with mycelium from *Corylus* or vice versa, infection was less severe than when the fungus was taken from the same host.

The author believes the fungus to be a degenerate form of *Sclerotinia* only producing microconidia, but considers that it should be referred to the genus *Moniliopsis* as *M. foliicola* (Woronich.), Siemaszko ad interim, a revised Latin diagnosis of the species being given.

COSTER (C.). **Die physiologische und pathologische Kernholzbildung bei Tectona grandis L.f. nebst Bemerkungen über die Bildung des Wundholzgummis.** [The physiological and pathological formation of heartwood in *Tectona grandis* L.f. with observations on the formation of callus gum.]—*Ann. Jard. Bot. Buitenzorg.*, xxxiv, 1, pp. 1–15, 3 pl., 1924.

Teak (*Tectona grandis*) trees are stated to be extremely susceptible to injury and immediately to form callus when wounded. The outer layer of the wood rapidly becomes desiccated, and the cells are almost completely interpenetrated by fungous hyphae. Beneath this external layer is a zone of varying width in which the cells of the medullary rays, the wood parenchyma, and often also the libriform fibres and even the tracheids are partially filled with typical wound gum, containing granules and concave spherical bodies, light to dark brown in colour. Sometimes the gum occupies the cell as a finely granular mass.

The wound gum is insoluble in water, alcohol, ether, acetone, acetic acid, concentrated chloral hydrate, cold concentrated nitric acid, cold sulphuric acid, and hydrochloric acid; it is partially soluble in potash lye (hot and cold), and quite soluble in hot nitric acid, staining yellow with aniline sulphate. It does not form a uniform mass, but varies considerably in colour and solubility. In all these respects the wound gum of Java teak is identical with that formed by European trees. The wound gum zone is succeeded by a darker zone, characterized by large drops of resin, which may extend as far as the normal heartwood.

It was demonstrated by four different methods that the wound gum formation in *T. grandis* is caused by the activity of the wood enzymes in the presence of sufficient moisture and independent of that of oxygen. The process of callus formation must be distinguished from that of heartwood production, which is a perfectly normal phenomenon in old and dying wood.

HUMPHREY (C. J.). **Decay of poles and the fungi which cause it.** *Rept. Spec. Comm. on Wood Preservation Amer. Electric Railway Engin. Assoc.*, 312, Appendix A, pp. 52–63, 3 pl., 1923. [Received 1924.]

In the present paper the author discusses the decay of the species of timber most generally used in the United States for telegraph poles, namely, the cedars [*Thuja* spp.], southern pine [*Pinus palustris*], cypress [? *Taxodium*], and chestnut [*Castanea*].

A summary is given of the data, admittedly incomplete, that have been hitherto collected regarding the durability of different species used as poles in various parts of the United States, and a table of the relative durabilities, taking the life of white oak [*Quercus alba*] poles as a standard. The chief factor in the shortening of the life of poles in service is decay, mainly due to

wood-destroying Basidiomycetes; moulds and bacteria play but a small part in the primary disintegration of the wood, although they may hasten, as secondary organisms, the decay initiated by the higher fungi.

The fundamental requirements for the growth of wood-rotting fungi, namely, a suitable supply of food, moisture, and air, and a favourable temperature, are discussed, and a short account is given of the heart or butt rots which develop in the standing living tree and of the rots which enter after the poles are cut, together with a summary of the measures to combat such rots.

The following species of wood-decaying fungi are briefly described, with notes on their relative importance, the species of timbers which they usually attack, and the type of rotting induced by each:—*Lenzites saepiaria, L. trabea, L. berkeleyi, L. striata, Lentinus lepideus, Polystictus abietinus, P. membranaceus, P. sericeo-hirsutus, P. pergamenus, Trametes sepium, Polyporus licnoides, P. spraguei, P. sulphureus, Daedalea quercina, Fistulina hepatica, Stereum fasciatum, S. rameale, Schizophyllum commune*, and *Peniophora gigantea*.

Bondartzeva-Monteverde (Mme. V. N.). К микофлоре Орловской губернии; новые виды паразитных грибов. [Contribution to the mycoflora of the government of Orel: new species of parasitic fungi.]—*Болезни Растений* [*Plant diseases*], *Monitor Phytopath. Sect. Chief Bot. Gard. R.S.F.S.R.*, xii, 2, pp. 70–72, 1923. [Received 1924.]

In this note are given the Russian and Latin diagnoses of seven new species of parasitic fungi collected by the author in 1915 and 1916 in the government of Orel [central Russia], of which the following are of interest.

Phyllosticta sinapi sp. nov. forms spots on both sides of living leaves of *Sinapis alba*, the spots being irregularly rounded, from 5 to 10 mm. in diameter, pale yellow, without a sharply defined margin, and ultimately drying up and falling out. The pycnidia are fairly numerous, scattered, blackish, immersed, and from 100 to 140 μ in diameter. They are composed of an indistinctly cellular tissue, walnut-brown in colour, and have a small and circular ostiole surrounded by a narrow ring of darker cells. The spores are ellipsoid, 6 to 8 by 3 μ in diameter, and hyaline.

Ascochyta brassicae-rapae sp. nov. causes rounded spots on both sides of living leaves of *Brassica rapa*, which are from 5 to 10 mm. in diameter, cream-coloured, with a narrow brown margin, and later fall out. The pycnidia are numerous on the upper side of the leaf, scattered, semi-immersed, and from 100 to 200 μ in diameter. Their structure is pseudopycnidial and they are composed of a tissue of distinct minute cells of a walnut-brown colour. The ostiole is from 16 to 20 μ in diameter and surrounded by a dark coloured ring of cells. The spores are cylindrical, rounded at both ends, straight, hyaline, indistinctly septate in the middle, and measure 7 to 10 by 3 to 3·5 μ.

Ascochyta spinaciae sp. nov. causes spots on both sides of living leaves of *Spinacia oleracea* which are rounded or angular, frequently limited by the veins, from 3 to 10 mm. in diameter,

later coalescing, and of a walnut-brown colour. The pycnidia develop on the upper side of the leaf, and are numerous, covered by the epidermis, pseudopycnidial in structure, composed of a thin, indistinctly cellular tissue, from 100 to 160 μ in diameter, and with a small ostiole. The spores are cylindrical, rounded, with one septum, and from 6 to 10 by 3 to 3·5 μ in diameter.

Ascochyta capsici sp. nov. forms spots from 3 to 5 mm. in diameter on both sides of living leaves of *Capsicum annuum*, walnut-brown in colour with an amber-coloured margin. The pycnidia appear on the upper side of the leaf and are scattered, from 120 to 160 μ in diameter, composed of an indistinctly cellular tissue of a light brown colour, the ostiole being from 12 to 20 μ in diameter and surrounded by a ring of dark coloured cells. The spores are cylindrical, sometimes bent, rounded at both ends, with one septum, hyaline, and measure 8 to 10 by 3 μ.

SIDERIS (C. P.). **Species of Fusarium isolated from Onion roots.** —*Phytopath.*, xiv, 5, pp. 211–216, 3 pl., 1924.

In a study to determine the causal organism of pink root of onions [see this *Review*, i, p. 405], twenty different species and varieties of *Fusarium*, of which six are new, were isolated from dead and diseased material near Stockton, California.

The species already known are listed, and the morphological and cultural characters of the following new species and varieties (all belonging to the section *Elegans*) briefly described: *F. cromyophthoron*; *F. rhizochromatistes* (also occurring on potato and millet with symptoms of pink root); *F. rhizochromatistes* var. *microsclerotium*; *F. sclerostromaton*; *F. loncheceras*; and *F. loncheceras* var. *microsporon*.

The development of certain morphological characters was observed to be influenced by the chemical nature of the substratum. In media rich in peptone and poor in dextrose aerial mycelium was abundant and the production of sporodochial macroconidia poor, the reverse taking place when dextrose was in excess as compared with peptone.

WALKER (J. C.). **Observations on the cultivation and diseases of Cabbages and Onions in Europe, 1922.**—*Plant Disease Reporter, Supplement* 32, 34 pp., 1924. [Mimeographed.]

These notes on the cultivation and diseases of cabbage and other cruciferous crops and onions (including also leeks in England and garlic in Spain) in various European countries are based on data collected during a tour of inspection made under the auspices of the United States Bureau of Plant Industry in 1922.

The principal fungous and bacterial diseases are enumerated, and the methods of cultivation practised in England, Denmark, Holland, France, Spain, and the Canary Islands are described. An interesting account, accompanied by statistics and notes on packing, grading, and shipping, is given of the important onion export trade of Spain and the Canary Islands.

WALKER (J. C.). **Cabbage-seed treatment.**—*U.S. Dept. of Agric. Circ.* 311, 4 pp., 2 figs., 1924.

Directions are given for the control of blackleg [*Phoma lingam*]

and black rot [*Bacterium campestre*] of cabbage, the symptoms of which are briefly described, by immersing the seed in corrosive sublimate or hot water. The former is recommended as the simpler and more practical method in the case of black rot alone, but when infestation with blackleg is to be feared, hot water should be used. Great care is necessary in the application of the hot water treatment owing to its tendency to reduce germination, especially in the case of old or shrivelled seed.

KATTERFELD (B. O.). Некоторые наблюдения над Plasmodiophora brassicae Wor. [Some observations on *Plasmodiophora brassicae* Wor.]—*Болезни Растений* [*Plant diseases*], *Monitor Phytopath. Sect. Chief Bot. Gard. R.S.F.S.R.*, xii, 1, pp. 11–14, 1923. [Received 1924.]

The present paper briefly describes some experiments made in 1922 at the Central Phytopathological Station [Leningrad] with a view to elucidating some questions in the biology of *Plasmodiophora brassicae*.

The duration of the period of incubation was tested by growing cabbage seedlings, showing under the microscope no signs of the disease, in earth thoroughly sterilized with formalin, and then infecting them at various stages of development, namely, at 15, 25, 30, and 45 days old respectively, by pouring spore suspensions on their roots. In each case the first symptoms of disease (a slight hypertrophy of the roots) appeared on the 10th day after infection. In seedlings raised in earth artificially infected the first symptoms appeared 25 days after the appearance of the seedlings above ground.

The influence of various fertilizers on the disease was investigated by growing cabbage seedlings in sterilized soil and transplanting them on 1st July into infected soil treated five days previously with lime, superphosphate, and wood ash respectively. On the 10th September the cabbages grown in the limed soil appeared free from infection, while those growing on soil fertilized with superphosphate were strongly infected; wood ash seemed to reduce the intensity of, but not to eliminate, the infection. Cabbages grown in soil with stable manure, and with a fertilizer composed of superphosphate, wood ash, and Chile saltpetre, had the same amount of disease, although those in the manured soil grew more vigorously and attained a larger size than those receiving the fertilizer.

Cross-inoculation experiments showed that seventeen species of Cruciferae [which are named] were susceptible to infection; ten showed 100 per cent. infection and seven varied from 90 to 13 per cent. Eight species (among which were *Capsella bursa-pastoris* and *Lepidium sativum*) did not contract the disease.

MOORE (W. D.). **Root and stem rot of Peas.**—*Forty-third Ann. Rept. New Jersey Agric. Exper. Stat. for the year ending June 30, 1922*, pp. 572–573, 1923. [Received 1924.]

Root and stem rot of peas [see this *Review*, iii, p. 634] which has caused very severe losses in New Jersey (ranging from 25 to 75 per cent. of the crop in 1921), has been found to be constantly

associated with a species of *Fusarium* which, in culture, developed most luxuriantly in a practically neutral medium at a temperature of about 80° F. Inoculation tests, in which the seeds were covered with a spore suspension of the organism at planting, gave positive results. In the field the disease, which is most prevalent on light, well-drained soils, appears to be disseminated chiefly by rain and farm implements.

SCHENCK (ERNA). **Ueber das Auftreten einer Hypochnusart auf Zuckerrübe.** [The occurrence of a species of *Hypochnus* on Sugar Beet.]—*Centralbl. für Bakt.*, Ab. 2, lxi, 11–18, pp. 317–322, 8 figs., 1924.

Three diseased sugar beet plants from the garden of a sugar factory near Magdeburg were submitted for inspection in the spring of 1923.

The leaves were covered with a cobweb-like network of fungous mycelium, which on some leaves developed a spore stage resembling that of *Hypochnus* [*Corticium*] but not absolutely identical with any known species. The hyphae spread over the under side of the young leaves, gradually extending to the veins, margins, and petiole. The upper side was less frequently invaded. In a damp atmosphere the mycelium developed luxuriantly in veils depending from the leaf margins, mid-rib, and petiole. The development of the leaves was arrested and early death resulted from the attack.

The network of hyphae was the result of numerous anastomoses. The mycelium was not found in the interior of the leaves, but incipient penetration of the stomata was observed. The hyphae were hyaline at first but turned brown later; clamp-connexions were not found.

The fertile parts of the mycelium on the under side of the leaves were perceptible to the naked eye by their granular or pulverulent appearance. This was due to the development of short, small-celled, lateral branches, profusely ramified and forming small tufts, which arose from the main hyphae. The enlarged terminal cells of these branches became basidia, on which were formed four sterigmata from each of which a spore was abstricted.

The basidia measured 16·8 by 10·8 μ and the spores 10·05 by 6 μ, while the main hyphae averaged 8·4 μ in thickness. The mycelial cells were plurinuclear and those of the fertile hyphae (basidial clusters) generally binuclear.

Sclerotia were formed on the leaves and on the surface of the root. They were brown, 1 to 3 mm. in diameter, and covered with a loose mycelial weft.

The fungus was grown in pure cultures, in which numerous sclerotia were formed and a brownish tinge was imparted to the medium. Spore formation did not occur on any of the media used.

The results of inoculation experiments showed that the mycelium was capable of spreading from diseased to healthy leaves in a humid atmosphere, but failed to cover the whole plant or to cause symptoms of disease. Newly opened leaves were infected by contact with fragments of the fungus, but no permanent injury or arrest of development ensued.

No connexion could be demonstrated between *Rhizoctonia violacea* var. *betae* and the *Hypochnus* in question. A comparison of the two mycelia on sugar beet showed differences in colour, habit of growth, and effect on the host. The *Hypochnus* mycelium was light brown and that of *R. violacea* reddish-brown; the former developed more rapidly than the latter and did not produce the decay of the host tissues characteristic of *R. violacea.*

Inoculation experiments with the beet *Hypochnus* on potato plants gave negative results, and the question of its identity with *H. solani* [*Corticium solani*], with which it agrees in spore measurements, must therefore be left open. The provisional name of *H. betae* or *Corticium vagum* [*C. solani*] var. *betae* is proposed.

The fungus is not regarded as of great economic importance, but is stated to be of botanical interest as the first record of the occurrence of a Basidiomycete on the sugar beet.

KLOTZ (L. J.). **Studies on Michigan Celery Diseases. II. A study of the early blight fungus, Cercospora apii Fres.**—*Michigan Agric. Exper. Stat. Tech. Bull.* 63, 34 pp., 7 pl., 1923. [Received Sept. 1924.]

Early or leaf blight of celery (the former term being the more descriptive), a disease of practically world-wide distribution, was first reported from the United States in 1881, since when it has caused considerable damage, especially in California and Florida. The causal organism, *Cercospora apii*, has frequently been reported to occur on other Umbelliferae, but no confirmatory data are available in support of these statements. The author has succeeded in infecting only two hosts with *C. apii*, namely, celery (*Apium graveolens*) and celeriac (*A. graveolens* var. *rapaceum*).

The first symptom of the disease, which appears during the hot weather of July and August and is particularly severe in dry soil, especially if associated with heavy dews, consists of an outbreak of numerous yellowish or pale greenish spots, 1 mm. or more in diameter, eventually coalescing into indefinite, approximately elliptical areas, the healthy tissue adjacent to which becomes slightly wrinkled. The borders of the lesions, which are more numerous near the leaf margin, are frequently somewhat raised. The colour of the spots changes progressively to light brown, reddish-brown, and dull slate or ashen grey as the fruiting structures appear. The fungus occurs also on fallen stalks, occasionally on the living petioles, and probably on the seed. Successful inoculation experiments were carried out on celery and celeriac plants with monospore cultures of *C. apii*, and infection was further secured by shaking overwintered celery refuse over healthy plants.

The fungus enters its host through open stomata. The intercellular mycelium, which is provided with haustoria, is composed of irregularly septate hyphae, 2 to 3·5 μ in width (or 4 to 5·5 μ when forming the stroma-like masses from which the fruiting structures arise), and hyaline when young but turning light brown with age. Dark brown, sclerotium-like hyphal masses, 20 to 50 μ in diameter, occur in the sub-stomatal spaces, and from these the fascicular conidiophores arise. The brown, septate conidiophores

measure usually 40 to 60 by 3·5 to 5·5 μ and show two to six distinct circular scars with a small, circular, central dot representing the point of attachment of the spores, the conidiophore showing at each such point a geniculation caused by renewal of growth from just below the terminally borne conidium.

The usual dimensions of the subhyaline, 4- to 12-cellular, obclavate conidia are 55 to 100 by 4 to 4·5 μ. Conidia which had over-wintered in the open were found incapable of germination in the following spring, the perpetuation of the fungus being secured by the stroma-like masses of mycelial hyphae described above.

The fungus makes most rapid progress in old leaves, producing spots in 5 to 8 days, while a period of 10 to 14 days is required to cause similar effects in young heart leaves. Infection was found to occur equally in light and darkness.

Field observations and greenhouse experiments under controlled conditions [which are described at considerable length] showed that the best vegetative growth of *C. apii* takes place between 25° and 30° C., 10 minutes' exposure at 48° being fatal to the conidia and at 51° to the conidiophores and mycelium. The conidia germinated best at 27° to 29°. No germination occurred after 12 hours' exposure to 42°. The moisture requirements of the fungus are supplied by dew, high humidity, and light rains, the most severe infection occurring when these conditions follow a drought.

The cultural characters of the fungus on various nutrient media are described. Good growth was secured on various common media. In a buffer solution of primary potassium phosphate-sodium hydroxide germination took place through the entire range of P_H values (5·8 to 8·0), with a maximum at 7·0. In potassium acid phthalate-sodium hydroxide germination occurred between P_H 4·6 and 5·4. The fungus was shown to be capable of normal growth with very small quantities of free oxygen, but could not live in the complete absence of air. Relatively high concentrations of carbon monoxide failed to inhibit growth.

No perceptible difference in the reaction of twelve varieties of celery to the disease was observed. Control may be effected by cultivation on very fertile, well drained, and moist soil, supplemented by frequent applications, throughout the vegetative period, of 4–4–50 Bordeaux mixture.

A bibliography of 73 titles is appended.

Suematu (N.). **Ueber eine Botrytiskrankheit der Erdnuss (Arachis hypogaea L.).** [A *Botrytis* disease of the Groundnut (*Arachis hypogaea* L.).]—*Japanese Journ. of Botany*, ii, 1, pp. 35–37, 2 pl., 1924.

Severe attacks of *Botrytis* on groundnuts (*Arachis hypogaea*) at the Komaba Botanical Institute, Tokyo, during persistent wet weather in the autumn of 1914, resulted in a moistening and black discoloration of the stems, on the surface of which greyish-white conidia were formed in profusion; the pods scarcely ripened and became covered with dark-coloured sclerotia.

The fungus was readily cultivated on various nutrient media. On favourable substrata the mycelium makes a luxuriant growth in two days, the sides of the test tubes showing numerous appres-

soria. These are at first hyaline and furcate, rapidly forming numerous olive to dark brown, septate branches which develop in a week into large, black bunches. At the same time conidiophores with one or two branches are formed, the branches being so compact that the whole aspect of the culture resembles a bunch of grapes. The conidiophores, which measure 1 to 2 mm. by 10 μ, elongate and form spore-heads repeatedly. The oval or elliptical conidia, which measure 7·5 by 6·25 μ, are very loosely attached to the conidiophores.

The formation of sclerotia begins immediately after that of the conidia, the hyphae becoming profusely ramified and producing a hyaline, spherical body which subsequently turns dark brown and assumes an irregular shape.

Inoculation experiments with conidia from sclerotia produced the typical symptoms of the disease on a healthy groundnut seedling, the mycelium developing in a week and the snow-white (later nearly black) sclerotia in 18 days. The delicate portions of the plant were the first to be infected, as in nature.

The species of *Botrytis* concerned is not indicated.

NAGORNY (P. T.). Несколько слов о вайт-роте в пределах Грузии в 1922 году. [A few words on white rot in Georgia in 1922.] —*Болезни Растений* [*Plant diseases*], *Monitor Phytopath. Sect. Chief Bot. Gard. R.S.F.S.R.*, xii, 1, pp. 1–4, 1923. [Received 1924.]

In 1922 the vine—one of the most valuable crops in Georgia [Caucasus]—was heavily attacked by livid rot, caused by *Coniothyrium diplodiella* [see this *Review*, iii, p. 186], in addition to mildew [*Plasmopara viticola*] and *Oidium* [*Uncinula necator*] which are more or less endemic in the country. Mention is made of the previous severe outbreaks of the fungus in this region, the most noticeable of which occurred in 1911 and 1912. It has been observed that the fungus most frequently appears in vineyards injured by hail, and that vines growing on hill slopes are much less susceptible than those growing in the plains.

The investigations hitherto made both in Russia and abroad show that the fungus generally attacks first the fruit-stalks, whence it passes to the young grapes, which it ultimately kills, the course of the disease being accompanied by specific and very characteristic symptoms [which are briefly described]. More rarely it attacks the young and still herbaceous shoots, but it has never been observed on the leaves, at any rate in the Caucasus.

An outbreak, in 1922, in a small local nursery was characterized by the appearance of the fungus on the above-ground portions of about 7 per cent. of the vine-cuttings, this being a form of attack hitherto unknown. The course of the disease resembled that on the young shoots: in the invaded areas (one to several on a cutting and measuring from 0·5 to 4·5 cm. in length), the bark gradually peeled off, denuding the underlying wood, and the whole area was covered by an almost continuous coating of black pycnidia. The pycnidia were round or almost elliptical in shape, and had a projecting ostiolum which remained for a considerable time covered by fragments of the stroma, so that the fruit bodies appeared to be

almost entirely closed in. At the bottom of the pycnidia were thick tufts of conidiophores, from which were abstricted dark brownish, ovoid or elliptical (more rarely fusiform) conidia, measuring 9 to 12 by 5 to 7 μ.

NISIKADO (Y.). **Ueber die durch Physalospora und Coniothyrium verursachten Krankheiten der Weintraube in Japan.** [The diseases of the Vine caused by *Physalospora* and *Coniothyrium* in Japan.]—*Ber. Ohara Inst. landw. Forsch.*, ii, 3, pp. 273–289, 1 diag., 1923. [Received 1924.]

Three fungi are stated to be responsible for a group of serious vine diseases occurring in the west of Japan, namely, *Glomerella rufomaculans*, *Physalospora baccae*, and *Coniothyrium diplodiella*. The author's extensive researches on the two last-named have been published in Japanese (*Ann. Phytopath. Soc. Japan*, i, 4, p. 20, 1921, and *Journ. Plant Prot.*, iv, 1, p. 68, 1917), with an English summary of the former paper added [see this *Review*, i, p. 101]. In the present paper a brief account is given of previous work on these diseases, with a description of their symptoms and of the morphology of the causal fungi, which were studied in pure culture.

The results of experiments in the determination of the hydrogen-ion range of *P. baccae* showed the optimum development to occur at P_H 4·2 to 7·4. No growth was made below P_H 3 or above 10.

C. diplodiella [see last abstract], a fungus which generally appears in Japan about the middle of June, has not been observed, as in Europe, to occur on the mature wood of the vine. The mycelium is hyaline and the sub-epidermal pycnidia globular or somewhat compressed. The pycnidial wall, consisting of several parenchymatous layers, is thick and brown or greyish-brown. The diameter of the pycnidia is 150 to 200 μ, and they contain simple, hyaline sterigmata, 9 to 20 by 2 to 2·5 μ, which arise only from the base. The unicellular, oval, ellipsoid, or fusiform conidia, tapering at both ends and hyaline to dark or olive brown in colour, are stated to agree with the descriptions already published. In culture the pycnidia are developed in about five days.

Positive results were obtained in inoculations with *C. diplodiella* on wounded grapes only, the unwounded and the controls remaining healthy.

A list of literature references is appended.

DUFOUX (A.). **Pour éviter le pourridié de la Vigne.** [On the prevention of root rot of the Vine.]—*Rev. de Vitic.*, lx, 1560, pp. 379–380, 1924.

Root rot [*Rosellinia necatrix*] generally attacks vigorous vines with more virulence than others, and the disease, being contagious, occurs in patches which increase in area year by year. It has recently been recorded in the Beaujolais region, where a particular case was closely studied. The attack, which began in 1914 on vines planted in 1908, was traced to infection from old tree roots left in the ground. At present 1,500 sq. m. are affected and some 50 vines have been pulled out.

As no effective remedy is known, the only way to control the disease is by pulling out the affected vines as soon as possible, together with those immediately adjoining, care being taken to remove the whole of the root system. The affected area is then surrounded by a trench, 0·5 to 1 m. deep, the earth being thrown up on the inside, and it may be sown with cereals or other annual crops having a shallow root system for 5 or 6 years, after which vines can be replanted. Disinfection of the soil with carbon bisulphide, owing to its high cost, can be recommended only for vineyards of quality.

To prevent the disease from appearing in vineyards it is absolutely necessary before planting to remove all old roots and stumps of trees or of vines from previous plantings. The practice of resting the soil for several years before replanting is an additional safeguard against root rot.

Ravaz (L.). **Chronique : Pour éviter la coulure.** [Current events : to prevent 'coulure'.]—*Prog. Agric. et Vitic.*, lxxxi, 22, pp. 509–511, 1924.

'Coulure' of the vine [see this *Review*, iii, p. 378] may occur before, during, or after flowering. In the first case the flowers do not develop, only the axis of the grape-cluster being formed. This type is attributed to insufficient nutrition consequent upon low temperatures, coupled with reduced powers of assimilation: intrinsically vigorous varieties, like Grenache and Rupestris, are the chief sufferers. In the second form the flowers fall off as soon as they open, either because pollination has not taken place or because the plant is unable to nourish the young fruit. The cause is often to be found in low temperatures, but unbalanced nutrition also plays a part. In the third type the berries fall off, either as soon as they are formed or subsequently. This shedding may continue for some time, and it is not unusual for the vines to lose all their fruit and even the grape-stalks. Though not definitely due to low temperatures, the cause in this case also is connected with impairment of the powers of assimilation by lack of sunshine resulting in inability to balance the growth activity.

As remedial measures the author recommends cutting back the shoots before or during flowering for a distance including 5 to 7 leaves (according to the vigour of the plant), together with ringing the branches of the old wood of the previous year. Both operations result in the concentration of nourishment in the grape clusters.

Ravaz (L.) & Verge (G.). **Un cas singulier de rabougrissement.** [A singular case of stunting.]—*Prog. Agric. et Vitic.*, lxxxi, 22, pp. 518–522, 2 figs., 1924.

A condition of stunted growth of unknown causation was observed by the authors in 1924 on vines which during the preceding season had shown excellent development. Vines grafted on Rupestris and growing in rich, low-lying soil are most subject to this condition, which has been observed in a number of localities,

though those grafted on Riparia, 420, and other varieties, were not immune. Affected plants do not die (though their yield is naturally very much reduced) but after a time resume their normal growth.

The stunting is due to delayed resumption of growth in the spring, the buds only starting growth when normal vines have developed shoots 20 to 30 cm. long. Very numerous buds develop on the affected shoots, several often pushing out successively from each eye, but each ceases to grow after a little time. Subsequently the buds on the older wood show a similar development, and later on those on the main stem. These late shoots grow more vigorously than those on the young wood, with the result that the crown of the vine becomes cup-shaped.

This condition resembles the Swiss acariose [due to *Phyllocoptes vitis*: see this *Review*, iii, p. 75], but no foreign organism has been found on either the buds or the leaves. The structure of the buds is in every way normal, nor can the stunting be referred to faulty root development.

BOURNE (B. A.). **Report of the Assistant Director of Agriculture on the entomological and mycological work carried out during the period under review.**—*Rept. Dept. of Agric. Barbados, 1922–1923*, pp. 7–9, 1923. [Received 1924.]

A case was observed in which some 50 per cent. of young beet seedlings 'damped off' shortly after germination. The causal fungus was isolated in pure culture and was identified as a species of *Peronospora* [? Peronosporaceae] by the method of oospore formation and by the characteristics of the non-septate mycelium.

A severe outbreak of *Phomopsis vexans* on eggplants was recorded on the grounds of a vegetable grower. A large number of the fruits rotted from the stem end before maturity.

A disease of guava (*Psidium guajava*) fruits was observed which caused almost complete loss of the fruit. Indications of rot at the blossom end appeared before the full maturation of the fruit. The internal tissues were found to contain a fungal mycelium which caused the cells to break down. Cultures gave abundant fructifications of what appeared to be a species of *Gloeosporium*, with granular, yellowish spores, 10·8 to 21·6 by 5·4 to 6·8 μ in diameter. The fungus is thought to be probably identical with *Glomerella psidii* (Del.) Shel. Control measures recommended are the application of Bordeaux mixture about every three weeks after the setting of the fruit, and the removal and incineration of all diseased fruit.

Towards the end of October 1922 many smutted heads of 'sour grass' (*Andropogon intermedius* var. *acidulus*) were observed in various localities. The fungus produced smooth, spherical spores, mostly 8 μ in diameter, which germinated in a manner typical of the genus *Ustilago*.

Elsewhere in the Report it is stated that there was a considerable reduction in the incidence of sugar-cane mosaic during the year, except on the small holdings of the peasants.

Brooks (A. J.). **Report on the agricultural position and requirements of the Gambia.**—12 pp., 1923. [Received 1924.]

This is the first report of the Director of Agriculture of the Gambia, where an Agricultural Department was created in 1922.

Groundnuts [*Arachis hypogaea*], which are the only exported crop, are reported to be severely attacked by leaf spot disease (*Cercospora personata*). An attempt to obtain seed from plants free from the disease was unsuccessful, as all the farms visited were found to be infected. There appear to be two other diseases present, one of which is believed to be the rust *Uredo arachidis* and the other is an unidentified disease probably of the roots. The examination of numerous samples from stacks in the field and from the trade dépôts showed a very high percentage of the nuts to be shrivelled either from disease or from being harvested too soon, the former being believed to be the chief cause of the injury.

Bolley (H. L.). **Biology.**—*Rept. of Director, N. Dakota Agric. Exper. Stat., July 1921 to June 30, 1923*, pp. 27–35, 1924.

The testing of varieties of flax for resistance to wilt (*Fusarium lini*) has been carried out on a large scale with very promising results. The fibre varieties have shown great resistance.

The incidence of root and seed diseases of wheat was not appreciably affected by manurial treatment. Scab [*Gibberella saubinetii*] and black point of wheat [see this *Review*, i, p. 289] were not controlled in the D–1 (Monad) variety by seed disinfection with formaldehyde 3 in 1,000 for 5 minutes, crude creosote 20 in 1,000 for 15 minutes, or corrosive sublimate 3 in 1,000 for 15 minutes, the last-named treatment, in fact, destroying the entire lot of seed. Selection tests showed that black point is due to an internal infection which is transmissible by the seed. A fungus closely resembling *Helminthosporium sativum* was isolated from durum wheat with black-pointed grains showing 30 per cent. of internal infection. Another species of *Helminthosporium*, with a different type of mycelium and spores, also occurred on infected plants. The embryos of black-pointed seeds were found to contain mycelium, enlarged lesions being formed, in the presence of sufficient moisture, on the primary roots before their emergence from the seed coats. Spores developed beneath the seed coats in these lesions.

The conidia of *G. saubinetii* were constantly found on glumes of wheat affected with scab in the field, while the ascogenous stage occurred on overwintered maize stubble. Seedling and head blight were shown to be two distinct forms of the disease caused by this fungus under varying climatic conditions. Diseased grains are readily recognizable by their lightness and may easily be graded; infection was reduced in one case from 25 to 5 per cent. by this process. Good results in the control of the disease have been secured by seed treatment with hot water or chlorophol; formaldehyde only destroys the spores on the surface. The best yields on soil infected with *G. saubinetii* were given by D–1, D–46, D–5, Kota, Black Chaff, and Kubanka in the order named.

Rye and maize were attacked by *G. saubinetii*, and one case of oat seedling blight occurred. Maize also suffered from ear and root rot.

Wheat varieties ordinarily resistant to black rust [*Puccinia graminis*], e. g. Kota, Monad, and the red durums, were found to be more or less susceptible when planted after the middle of May. No difference in susceptibility was observed between smooth Kubanka durum seed and that provided with a brush of hairs at the tips. The D–5 (Pentad) variety, as well as those mentioned above, has shown resistance to rust, while Haynes Bluestem and Marquis are susceptible (the latter also to scab). The barberry eradication campaign has been renewed as the result of discovering fresh growth of the shrub.

The combined salt and formaldehyde treatment of wheat seed grain against ergot [*Claviceps purpurea*] caused a reduction of germination ranging from negligible to 51 per cent. after ten minutes' immersion. Good results (up to 4·5 per cent. increase of germination were, however, obtained when the grain was first immersed in the salt solution, then rinsed immediately after removal and formalin applied [see this *Review*, ii, p. 498].

Potatoes with discoloured stem ends were found to be carriers of *Fusarium* wilt (*F. oxysporum*), blackleg (*Bacillus phytophthorus*) [*B. atrosepticus*], and other diseases in a large number of cases, and the practice of removing the stem ends is therefore recommended. Potato dry rot (*F. discolor sulphureum*) was very abundant in storage bins.

Work and progress of the Idaho Agricultural Experiment Station for the year ended December 31, 1923.—17 pp., 1924.

The following references (on p. 13 of the report) are of phytopathological interest. Leaf roll of potatoes was sometimes found to appear late in the season in the form of a slight rolling of the younger leaves in otherwise vigorous plants. The progeny from such plants may develop advanced symptoms of the disease and yield practically nothing. The russet dwarf type of mosaic [see this *Review*, iii, p. 192] may behave similarly, a slight mottling late in the season being followed by severe damage to the progeny.

Inoculated sulphur applied at the rate of 300 or 600 lb. per acre gave fairly good control of potato scab [*Actinomyces scabies*] in two cases, but in most of the tests with this material the results were not satisfactory.

Bunt of spring wheat [*Tilletia levis*] was adequately controlled by copper carbonate dust, but with the winter varieties copper sulphate was more efficacious.

Wolf (F. A.). **Noteworthy plant diseases in North Carolina in 1922.**—*Forty-fifth Ann. Rept. N. Carolina Agric. Exper. Stat. 1922*, pp. 74–76, 1922. [Received 1924.]

Specimens of young cotton bolls which had been shed at various stages of development up to one-quarter inch in diameter, were submitted for inspection. Many of the bolls showed elongated, depressed lesions, covered with the pink conidia of *Colletotrichum gossypii*, on the portion of the pedicels immediately beneath the

bracts. In other cases the basal portions of the young bolls were attacked and discoloured. The infection is believed to have originated round punctures made by boll weevils [*Anthonomus grandis*] which presumably acted as agents of dissemination. This is believed to be the first record of boll shedding due to *C. gossypii*.

Downy mildew of watermelons and cantaloupes (*Plasmopara* [*Pseudoperonospora*] *cubensis*) was unusually destructive on account of the excessive rainfall and high humidity.

Strawberry leaf scorch (*Mollisia earliana*) [*Diplocarpon earliana*: see this *Review*, iii, p. 589] caused losses amounting to 20 to 30 per cent. of the crop.

Sclerotium rolfsii was reported for the first time on strawberries, the attack being characteristic and sclerotia developing within the disintegrated stems. The same fungus was found, for the first time in North Carolina, on tobacco plants.

Leaf blight of walnuts (*Cylindrosporium juglandis*) was also discovered in North Carolina. This is believed to be the first record of this disease in the eastern United States.

REDDICK (D.) & STEWART (V. B.). **Crown-gall of Apple and Peach with notes on the biology of Bacterium tumefaciens.**—*Cornell Agric. Exper. Stat. Mem.* 73, 19 pp., 2 pl., 2 figs., 2 diags., 1924.

The plan of a series of experiments carried out between 1910 and 1920 at Ithaca, New York, to ascertain the importance of crown gall (*Bacterium tumefaciens*) on apple and peach trees is described, and the results obtained are presented in tabular form.

As regards apple trees, the presence of crown gall lesions on the roots did not appear to interfere in any way with their growth, and at the close of the investigations scarcely any symptoms of the disease were discernible. In the locality in question, therefore, crown gall would seem to be of importance primarily to nurserymen, and evidence is adduced to show that, even in seedlings, the disease has no very serious or far-reaching effects [see this *Review*, iii, p. 496].

Similar results were obtained with peach trees, most of the galls having disappeared when the trees were examined in 1918 and those that remained having apparently caused no appreciable damage.

Tests to determine how long *Bact. tumefaciens* remains alive in the soil showed that in sterilized soil inoculated with pure cultures of the organism on 10th November 1914, the latter was still alive on 24th May 1915 but not on the following 14th September. It seems to live longer in moist than in dry soil. Penetration of the organism by percolation through 60 cm. of quartz and loam, but not always through the same depth of clay, was found to occur.

MAGROU (J.). **Tumeurs expérimentales dues au Bacterium tumefaciens.** [Experimental tumours caused by *Bacterium tumefaciens*.]—*Rev. Path. Vég. et Ent. Agric.*, xi, 1, pp. 73–77, 1924.

The author claims to be the first in France to attempt to re-

produce E. F. Smith's experiments on crown gall tumours, which he regards as of the greatest importance in comparative pathology.

Of 20 plants of *Pelargonium zonatum* inoculated by him with fresh subcultures of a strain of *Bacterium tumefaciens* maintained at the Institut Pasteur in Paris, 16 gave positive results. Ultimately the tumours were invaded by fungi (chiefly *Botrytis cinerea*) and rotted, while some were eaten by grubs; in the latter case new tumours were rapidly formed by budding at the bottom of the cavities made by the insects. Similar results were obtained from inoculation experiments on beetroot plants two months old.

Like Smith, the author did not succeed in his attempts to observe the organism inside the tumour tissues, although it was recovered by cultures from the latter [but see this *Review*, iii, pp. 15, 125, 386]. The strain thus obtained proved to have an exalted virulence to *Pelargonium*, inoculations of which succeeded in 100 per cent. of the cases and produced tumours more rapidly than the original strain. Secondary tumours were not observed.

Transverse sections of the galls on *Pelargonium* showed that they developed from the cambium. At the point of origin of the tumour on the stem, the activity of this layer is considerably increased and results in the formation of a mass of small differentiated cells which push asunder the ring of secondary wood from the ring of sclerenchyma outside the bast. Ultimately these two lignified rings are broken through by the neoplastic cells which invade both the pith and the bark. The tumours are formed by nucleate cells, rich in protoplasm and much smaller than the parenchymatous cells of the bark and pith. They are traversed in all directions by strands of still smaller and more deeply staining cells. Wood vessels, either isolated or in bundles, are frequently differentiated in contact with such strands. The tumour develops by sending from its margin, into the surrounding parenchymatous tissue of the bark, outgrowths formed of deeply staining small cells with abundant protoplasmic contents. The whole strikingly resembles a human cancer growth invading normal tissue.

In beetroot the tumours consist of parenchymatous tissue (the large cells of which are for the most part empty of protoplasm) traversed by numerous, irregularly disposed fibro-vascular bundles. In this case also, although not as clearly as in that of *Pelargonium*, the tumours appear to arise from the cambium.

COWDRY (E. V.). **The independence of mitochondria and the Bacillus radicicola in root nodules.**—*Studies Rockefeller Inst. Med. Res. Reprints*, xlvi, pp. 249–251, 1 pl., 1923. [Received 1924.]

A recent study of common white clover [*Trifolium repens*] root nodules by mitochondrial methods led Wallin (*Amer. Journ. Anat.*, xxx, p. 451, 1922) to re-affirm his theory that mitochondria are symbiotic bacteria. In the author's opinion, however, the evidence adduced in support of this view, especially with respect to the identification of the mitochondria, is inadequate.

The most specific stain for mitochondria in animal tissues, Janus green B, is stated to be almost useless when applied to plant cells, but the simultaneous and differential demonstration of mitochondria

and *B. radicicola* side by side within the same cells may be effected by fixing in Regaud's fluid and staining with aniline fuchsine and methyl green. Passing from the tip up the rootlet a series of cells is observed in which the mitochondria and *B. radicicola* can easily be differentiated, the latter being absent near the tip. Small forms of *B. radicicola* are distinguishable from the rod-shaped or occasionally filamentous mitochondria by their green colour, larger dimensions, and variable distribution in clumps in different cells. In slightly older cells the bacillus displaces the remaining mitochondria into the peripheral cytoplasm. Still farther from the root tip larger bacilli are observed, oriented at right angles to the cell wall and closely packed together side by side. About the middle of the nodule are observed roughly spherical organisms approximately corresponding to Wallin's 'senile forms'. In all these locations typical mitochondria occur in the same cells with the bacteria.

Further evidence of the independence of mitochondria and *B. radicicola* in the cells of root nodules may be obtained by bleaching the above preparations and colouring them with Giemsa's stain, the bacilli alone being specifically stained in cells known also to contain mitochondria. The destruction of the mitochondria by fixation in Bouin's fluid and 95 per cent. alcohol, while the bacilli remain apparently intact, is regarded as indicating a difference in chemical constitution between the two bodies.

JOHNSTON (T. H.) & HITCHCOCK (L.). **A bacteriosis of Prickly Pear plants (Opuntia spp.).**—*Trans. & Proc. Roy. Soc. S. Australia,* xlvii, pp. 162–164, 1923. [Received 1924.]

A brief description is given of the bacterial disease discovered by the senior author attacking *Opuntia tomentella* and *O. ficus-indica* in Miami, Southern Florida [see this *Review*, ii, p. 397], and of the causal organism which the author believes to be the first bacillus recorded as parasitizing Cactaceae and which is named *B. cacticidus.*

The disease is first marked by the appearance of a rounded, blackish area with usually a bright purple margin adjacent to a narrow, chlorosed zone separating it from the healthy tissue. The parenchyma underlying the lesion becomes completely disintegrated into a greenish to dark brown, slimy, and fetid liquid. The cuticle may sink somewhat, but in some cases it may bulge out under the pressure of the gas collecting below it as a result of the organism's activity. The infection does not advance along the vascular bundles and is not able to pass from the diseased cladode to that above or below, but progresses within the infected segment through the breaking down of parenchyma cells. Fully disintegrated segments may resemble dull green or grey-green cushions, distended by liquid and gas, but as there frequently is some opening allowing of the escape of these products of putrefaction, only a dried cuticle surrounding the vascular strands may remain.

Under cold and dry weather conditions the progress of the disease is very slow and the invaded cladode is then able to limit the lesion, the infected portion drying out and collapsing. Under suitable temperature and moisture conditions, however, the disease

advances too rapidly for the plant to check it, and usually results in the death of part or whole of the cladode. On the stems, the effect is somewhat similar, but very slow unless assisted by some inoculating agency, such as that of a boring insect larva.

The causal organism is an actively motile, Gram-negative, aerobic, and facultative anaerobic bacillus. On agar it is almost coccoid and about 8 μ in diameter, but in liquid media it forms short rods occurring singly or in pairs and measuring 8 by 1·3 μ. Neither spores nor capsules were observed. The optimum temperature for cultures was found to be between 28° and 30° C., which is regarded as evidence in favour of the organism being native in the tropical parts of America.

When grown in bouillon or agar, the virulence of the bacillus is considerably decreased. The greatest virulence was shown by cultures on prickly pear decoction after two days at temperatures from 20° to 25°. Diseased material desiccated for months retained its capacity to reproduce the disease.

Attempts to induce infection through the stomata either by smearing or spraying virulent cultures over the uninjured surfaces of cladodes failed, while detached cladodes, if allowed to dry sufficiently to heal the scar at the broken joint, did not become infected even after steeping the lower end of the segment for weeks in the liquid from decomposed material, though the infection was readily contracted when an injury was made in the immersed part of the segment.

It was ascertained experimentally that several cactus mothborers (*Melitara*) in their caterpillar stage are able to transmit the organism from diseased to sound portions of the same and other plants. The disease may also be carried by the larvae of the cactus longicorn beetles (*Moneilema*) and by the common ferment flies (Drosophilidae), while experiments carried out with four species of *Chelinides* cactus bugs gave negative results.

The effect of *B. cacticidus* on various crops and fruits was tested in the laboratory, with positive results only in the case of the more pulpy kinds of cucurbitaceous fruits, such as squashes, melons, and marrows. Under ordinary conditions of temperature, potatoes were not affected by inoculation, but if kept in an incubator at 37° C. decomposition was produced.

It is thought that *B. cacticidus* may play a very important part in the eradication of the prickly pear in Australia during the warm, moist summer, in collaboration with the larval stages of the moths *Melitara* and *Mimorista*, and to a less extent with the adult Drosophilid flies and of the larvae of the *Moneilema* beetles. It may be safely assumed that all the species of *Opuntia* occurring in Australia are susceptible to the disease, since seven of the commonest were successfully infected.

BERRIDGE (EMILY M.). **The influence of hydrogen-ion concentration on the growth of certain bacterial plant parasites and saprophytes.**—*Ann. of Appl. Biol.*, xi, 1, pp. 73–85, 3 graphs, 1924.

In view of the important part which hydrogen-ion concentration probably plays in the defence of plants against invading bacteria,

an investigation was undertaken to find out how far this factor affects the growth and activity of different types of bacteria. Fourteen plant parasitic species and various other bacteria were used in the experiments.

The determination of the maximum points of acid agglutination was based on the method recommended by Michaelis (*Deut. med. Wochenschr.*, xxxvii, Jahrg. 1, p. 969, 1911) for the identification of typhoid bacteria. The majority of the parasites showed marked resistance to the influence of acid. The agglutination of four non-parasitic members of the *fluorescens* group was similar, but sporing soil organisms (except *Bacillus subtilis*) agglutinated at much lower concentrations.

The degree of acidity at which growth ceases was determined. No growth was obtained in Jardox peptone broth with HCl at a greater acidity than P_H 4·4. A greater tolerance of acid was shown by most of the plant parasites and types allied to *B. fluorescens* than by *B. vulgare* and five sporing soil species.

The degree of alkalinity limiting growth was found to be approximately the same, namely, P_H 9·3 to 9·5 for all species tested (except seven which came between P_H 8·7 and 9·2, and one at 9·6), both parasitic and non-parasitic.

The changes in the hydrogen-ion concentration due to bacterial growth were ascertained by inoculating tubes of peptone water, with an original P_H value of 6·9, with 20 species of bacteria, and withdrawing small quantities each day for testing. Bacterial species with high agglutination maxima rapidly produced alkali in peptone water, while the 'ammonifying' (sporing soil) organisms with lower agglutination points produced acid during the first day or two and later gave an alkaline reaction.

In order to determine whether the initial acidity of the medium had any influence on the formation of alkali during growth, tubes of broth, adjusted to various P_H values, were inoculated, incubated at 21° C. for two days, and the change of P_H then determined. In the *Pseudomonas* and *B. fluorescens* group the reaction to acidity of the nutrient medium is very marked, the cultures giving greatest alkali formation being those of high initial acidity and not those of maximum growth. Rapid alkali formation in acid media is also characteristic of the parasitic forms allied to *B. carotovorus*, but this group shows a slight tendency to form acid in alkaline media. Most of the five sporing soil species tested, and also *B. vulgare*, in contrast with the plant parasites, formed acid at all H-ion concentrations during the first two days of growth, whilst the non-parasitic *B. lactis aerogenes* and *B. faecalis alcaligenes* were found to form alkali just as freely as many plant parasites.

Bacterial plant parasites, especially those of the *Pseudomonas* type, and the non-parasitic species of the *B. fluorescens* type, have high acid agglutination points and limits of growth, and a capacity to produce alkali rapidly in the presence of nitrogenous materials, whilst many sporing species (ammonifiers of the soil) have low agglutination points and limits of growth, and produce acid in the early stages of growth in sugar-free peptonized broth. H-ion concentrations as high as P_H 5·0 to 4·4, at which injury to bacterial growth begins, are seldom met with in plants except in acid fruits.

The higher acidities of plant extracts are too low to kill or even agglutinate most of the bacteria tested and would seriously check growth in the sporing species only.

LANGWELL (H.) & HIND (H. L.). **Cellulose fermentation. The utilisation of spent Hops and Grains.**—*Journ. Inst. of Brewing*, xxix, 5, pp. 302–310, 1923.

After a general discussion of the nature and value of cellulose and of the various attempts which have been made to evolve a process for its conversion into alcohol by acid hydrolysis, the authors give some details of a method of fermentation by a bacillus stated to be capable of fermenting any carbohydrate (even the most resistant cotton cellulose) almost as rapidly as glucose is fermented in ordinary yeast fermentation. The process is of a proprietary nature and full details were not divulged.

The organism in question is a slender bacillus, 4 by 0·4 μ, forming endospores of the drumstick type, and in a high degree thermophilic, the optimum temperature for its activity being 140° to 150° F. This last point is regarded as extremely significant, since the optimum temperature for the majority of enzymes is about 140°, and the coincidence of these two optima opens up a prospect of rapid fermentation quite absent in the case of yeast. At 150° F. the entire process of fermentation can be accomplished by the new bacillus in four days, and this discovery is being exploited, with considerable hope of commercial success, by the firm of Power Spirits Ltd., Epsom [England].

Obviously the enzyme by means of which the bacillus breaks down the cellulose to diffusible products must be active at 150°, and it is, therefore, presumably distinct from cytase, which is generally held to be destroyed at 140°. The enzyme is believed to be extracellular and highly unstable, fermentation being checked by any action inhibiting the vegetative activity of the cell.

The uses of various products furnished by cellulose fermentation (alcohol, acetic acid, methane, and hydrogen) are briefly discussed. A ton of fermentable matter is estimated to yield about 120 galls. of liquid products and 15,000 cu. ft. of gas. The majority of naturally occurring celluloses suitable for fermentation are stated to yield about 40 to 70 per cent. of fermentable matter, while the residue is suitable for use as a fuel.

Spent hops, a waste product of a cellulose nature which has hitherto found a limited sale as manure, litter, and fodder, appear from preliminary experiments to be suitable for this fermentation process, yielding about 40 galls., per ton of dry material, of a mixture of alcohol and acetic acid. The acetone and solvents obtainable from this are valued at about £10. Spent hops contain a minute quantity of copper, to which the cellulose-fermenting bacillus is extremely sensitive, but it is readily removable by the addition of hydrogen sulphide or other suitable reagent.

In the course of a discussion on this paper (pp. 310–320) in which various interesting points were raised, Mr. Langwell stated that the bacillus under consideration was almost as widespread in nature as cellulose itself, occurring, for instance, in horse manure

and on nettles. The organism is believed to be identical with that isolated from Neva mud by Omelianski, and although it has not been grown in pure culture, the cultures became purer with successive sub-culturing. It can work either under strictly anaerobic or mildly aerobic conditions. Fermentation is habitually conducted at 154·4° F., but on one occasion the bacillus was shown to have accidentally survived a temperature of 194°. The protective action of lignin was stated to be much more marked in wood than in cereal straw, in which the binding agent can be destroyed with a little dilute acid, rendering the greater part of the cellulose fermentable, while a very mild alkaline boiling would complete the process.

DADE (H. A.). **'Thread' diseases of Cocoa in the Gold Coast.**—*Journ. Gold Coast Agric. & Comm. Soc.*, iii, 1, pp. 9–12, 1923. [Received 1924.]

Of the two diseases of *Theobroma cacao* briefly described in this note, the one known as 'white thread' causes considerable defoliation and thus weakens the trees. The white threads are composed of fungus mycelium and one of the fungi concerned has been identified as *Marasmius scandens* Massee, while it is suspected that at least one other species can cause similar symptoms in the Gold Coast. The mycelial strands adhere closely to the twigs and leaves; on reaching the latter, they branch freely and spread out, usually on the under surface. The leaves are ultimately killed and become detached from the branch, but remain suspended by a strand of mycelium, thus giving the tree a characteristic appearance. The fructifications are in the form of thin, delicate, cream or fawn-coloured, mushroom-like sporophores from $\frac{1}{8}$ to $\frac{1}{4}$ inch in diameter, apparently without a stalk and attached to the mycelial strand by a point at one edge; they are not usually found in large numbers.

The disease (which is also found on forest trees and attacks kola [*Cola acuminata*] as well as cacao), is propagated by infected dead leaves blown about by the wind, which come into contact with the twigs and leaves of the healthy trees and from which the mycelium readily passes to the latter. It is easily controlled by the removal and immediate destruction of all the infected twigs and leaves, and its presence in a farm is indicative of defective cultivation.

The other disease, known as 'horsehair blight', is not dangerous in itself, as the causal fungus is a true saprophyte and does not directly injure leaves. Its eradication is, however, strongly advocated, as great masses of dead leaves and rubbish accumulate in the profuse growth of coarse, black, glossy, mycelial strands, which form a loose tangle attached here and there to the leaves and twigs. This accumulation gives rise to an unsanitary condition, harbouring pests and other dangerous fungi, and interfering with ventilation and illumination.

BEAUVERIE (J.). **Echelle de sensibilité des Blés à la rouille jaune, Puccinia glumarum, en 1923.** [Scale of susceptibility of Wheats to yellow rust, *Puccinia glumarum*, in 1923.]—*Rev. Path. Vég. et Ent. Agric.*, xi, 1, pp. 26–28, 1924.

This paper gives a list of pedigree and other varieties of wheat

arranged according to their degree of resistance to yellow rust (*Puccinia glumarum*) during 1923, at the Selection Station at Lafont, Puy-de-Dôme [France]. Each group is marked with a figure from 0 to 5 denoting increasing susceptibility from immune to highly susceptible. The same variety may appear in some cases in more than one of the groups, the explanation being that in such cases the seed either originated from different places or came from pedigree strains within the variety, exhibiting an unequal degree of resistance.

BEAUVERIE (J.). **Notes pour l'étude internationale des rouilles du Blé.** [Notes on an international study of Wheat rusts.]—*Rev. Path. Vég. et Ent. Agric.*, xi, 1, pp. 29–31, 1924.

Responding to the desire expressed at the International Phytopathological Congress held in 1923 at Wageningen [Holland], the author makes some suggestions regarding the organization of co-ordinated international research on wheat rusts, and the lines on which the work should be carried out by individual investigators. The results obtained each year should, it is suggested, be centralized in the hands of one general secretary, whose task would be to compare and analyse them and to draw conclusions as to the orientation of further researches.

FOËX (E.). **Quelques observations sur les conditions qui favorisent le développement et l'extension des rouilles des Céréales.** [Some observations on the conditions favouring the development and spread of rusts of Cereals.]—*Rev. Path. Vég. et Ent. Agric.*, xi, 1, pp. 32–41, 1924.

The author contrasts observations in 1906–1907 and 1921–1922 in various regions of France, and some communications received by him from abroad, with the conclusions arrived at by Beauverie [see this *Review*, ii, p. 361] on the development and spread of *Puccinia glumarum*, *P. triticina*, and *P. graminis* as influenced by meteorological conditions. Without disputing the accuracy of certain of these conclusions, he believes the problem to be much more complex than Beauverie's interpretation would admit, the more so as but little is yet definitely known of the mode of overwintering of the rusts, and as the meteorological instruments now in use do not register some phenomena, e. g., the condensation of water on leaves, which undoubtedly are important factors in the development of an epidemic. He also believes that the invasion of one year may be predetermined to some degree by the intensity of infection in the previous year, and that the number and localization of infection foci (which are never entirely absent, as is sometimes the case with other parasitic fungi, e. g., *Plasmopara viticola*) play an important part in the dissemination of the rusts.

HURD (ANNIE M.). **The course of acidity changes during the growth period of Wheat with special reference to stem-rust resistance.**—*Journ. Agric. Res.*, xxvii, 10, pp. 725–735, 5 graphs, 1924.

In the present investigation, undertaken with a view to studying

the relationship of the changes in acidity in the juice of wheat plants, at different stages of their development, to rust resistance, the same methods were followed as in the author's previous paper on the relation between acidity and disease resistance [see this *Review*, ii, p. 361]. The plants, belonging to six varieties representing extremes of resistance and susceptibility to stem rust (*Puccinia graminis tritici*), were grown in the greenhouse, but occasional control tests were also made with plants grown in the field.

The results [details of which are given in graphical and tabular form] show that the titratable acidity of the juice of all the varieties tested undergoes a regular sequence of changes from the seedling stage to maturity, these changes being more marked, in view of the high buffer content of plant juices, than those in hydrogen-ion concentration. At first there occurs a progressive decrease, the acidity declining sometimes to half the initial concentration between the ages of two and about six weeks from sowing. This is followed by a period of relatively low acidity, with minor fluctuations, extending to the visible approach of maturity, from which moment the acid concentration rises as the plants ripen and become dry. The final value may be twice the highest concentration in the seedlings and almost three times as high as that of the stage of minimum acidity.

The hydrogen-ion concentration does not decrease appreciably between the ages of two and six weeks; it increases greatly during the pre-ripening period, and reaches a relatively high value at the flowering stage and later. The increasing acid concentration during the final stages of growth appears to be correlated with the rate of drying (loss of water) rather than with spike or kernel formation. Stunted, slow-growing plants are characterized by an extremely high titratable acid and hydrogen-ion concentration, and may not have the intermediate period of low acidity. Likewise, plants of which the vigour was visibly affected by mildew, showed abnormally high acidity.

The extreme and regular variation in the acidity of the six varieties (including both resistant and susceptible kinds), taken with what is known regarding the influence of the stage of development of the host on susceptibility to rust, afford proof that acidity does not influence rust resistance. This is also shown by the fact that resistant varieties pass through the period of low acid concentration at the same stage as susceptible ones, and no breakdown in their resistance at this time has been recorded.

TAPKE (V. F.). **Effects of the modified hot-water treatment on germination, growth, and yield of Wheat.**—*Journ. Agric. Res.*, xxviii, 1, pp. 79–97, 5 pl., 1924.

Of recent years a number of community plants for seed treatment have been established in Indiana and Virginia, and in the present paper an account is given of a series of experiments conducted on co-operative lines in the control of loose smut of wheat (*Ustilago tritici*) by a modified hot-water treatment. This process consisted of (1) pre-soaking the grain for 4 to 5 hours in cold water; (2) momentary immersion in water heated to 49° C.; and

(3) immersion for ten minutes in water at 54°. The seed was left in a thin layer to dry for five or more days at room temperature. The germination of treated seed between moist blotters was found unreliable for an accurate determination of the effects of the treatment on the germination of the seed when transferred to the soil, and the method of germination in greenhouse soil was accordingly adopted.

The effects of this treatment were shown to be largely dependent on the varying composition of the soil in different localities and on the physical condition of the seed coats, which, in its turn, is influenced by such factors as the state of the weather during the period from ripening to threshing, the adjustment and velocity of the cylinder of the threshing-machine, the size of the wheat kernel, and the handling of the grain after threshing. Small, shrivelled kernels survived treatment as well as, or better than, large, plump kernels from the same lot of machine-threshed seed.

The effects of treatment on machine-threshed grain were very severe (54·6 per cent. germination in place of 87·9), and when the seed-coats were broken over the embryo, germination was reduced from 98·3 to 4·3 per cent. When the coats were broken over the endosperm the damage was somewhat less severe, but still very considerable. There was little or no reduction, but some retardation, in the germination of seed with unbroken coats. Any increase in the duration of pre-soaking rapidly accentuated the injury from the high temperature treatment when the seed coats were broken and relatively very slowly when they were unbroken. The rate of water absorption by the seed was more rapid when the seed coats were broken. It is suggested that the damage caused by the modified hot-water treatment to seed with broken coats may be due to the coagulation of leucosin in the embryo.

Plants grown from treated seed spaced in the rows were fewer in number and produced slightly fewer culms per plant than spaced plants from untreated seed. Under unfavourable soil conditions, the reduction in yield from treated seed was over four times as large as that from untreated seed, while the bushel weight of wheat grown from treated seed was not appreciably higher than that from the untreated lots.

Yield experiments were conducted for three years, in each of which the wheat grown from untreated seed outyielded that from treated seed (by 0·95, 7·1, and 6·0 bushels per acre respectively) when sown at the rate of 6 pecks per acre. However, in the third year, treated seed yielded 3·6 bushels per acre more than untreated smutted seed when sown dry at the rate of 12 pecks per acre to compensate for wheat killed by the treatment.

Garbowski (L.) & Leszczenko (P.). **Doświadczenia z zaprawianiem Pszenicy przeciw śniecy cuchnącej (Tilletia tritici).** [Experiments on the disinfection of Wheat against stinking smut (*Tilletia tritici*).]—Reprinted from *Nowiny Rolniczy* [*Agricultural News*], i, 5 pp., 1924.

A short account is given of a triplicated series of experiments made at the Plant Diseases Section of the State Institute of Agricultural Sciences in Bydgoszcz [Poland] in 1922–1923 to test the

relative efficacy of a 1 per cent. solution of copper sulphate, 0·1 and 0·2 per cent. solutions of formalin, and 0·25 per cent. solution of uspulun, for the disinfection of wheat seed-grain (Bensing's Trotzkopf, a highly susceptible variety) against bunt (*Tilletia tritici*).

The results, given in tabular form, showed that while the germination of the seed and the initial growth of the seedlings were appreciably stimulated by uspulun, this effect was rapidly lost and ultimately the stands in the various plots were more or less similar. The best results from the point of view of suppression of bunt were obtained by the formalin solutions (immersion from 10 to 30 minutes). Uspulun (0·25 per cent., immersion for $\frac{1}{2}$, and $1\frac{1}{2}$ hours, respectively) did not disinfect the seed sufficiently, and the results with copper sulphate (1 per cent., immersion for 2, 5, and 10 minutes) were still less satisfactory.

FRASER (W. P.). **'Take-all' of Wheat in Western Canada.**—Abs. in *Phytopath.*, xiv, 7, p. 347, 1924.

Ophiobolus cariceti is recorded as attacking a field of Marquis wheat rather severely in Northern Saskatchewan during 1923. Perithecia with mature asci were found.

KOEHLER (B.), DICKSON (J. G.), & HOLBERT (J. R.). **Wheat scab and Corn root rot caused by Gibberella saubinetii in relation to crop succession.**—*Journ. Agric. Res.*, xxvii, 11, pp. 861-880, 2 pl., 1 graph, 2 diags., 1924.

In 1919 the average percentages of wheat scab (*Gibberella saubinetii*) following crops of maize, wheat, rye, oats, clover, and timothy [*Phleum pratense*] respectively, were determined as 43·3, 29·2, 27·0, 22·7, 11·4, and 8·3, the figures being taken from a variable number of fields (10 to 47) in each of the following States: Illinois, Indiana, Iowa, Minnesota, Ohio, Tennessee, and Wisconsin. In 1920 the survey was confined to the McLean County of Illinois, and the average infection following maize, wheat, oats, and timothy was 4·6, 1·0, 1·7, and 0·2 per cent. respectively. In 1921 still more refined methods were used, and the results showed 17·4, 3·7, and 5·3 per cent. infection respectively, after maize, wheat, and oats. The data indicate that the relative abundance of scab each year varies with the previous cropping and is within the control of the farmer. The figures only refer to the head blight type of infection, but the total damage from the fungus may be presumed to have been much greater.

The losses resulting from root rot caused by the same fungus on maize following different crops were estimated by the comparative yields from susceptible and resistant strains of maize. In the first experiment, carried out at Bloomington, Illinois, in 1920, the disease-resistant seed gave after clover (for the two previous years and oats in 1917) 83·7 bushels per acre, but after scabby wheat (in 1919, maize 1918, oats 1917) only 72·1 bushels, a reduction of 13·9 per cent., while the disease-susceptible maize gave 72·9 and 54·4 bushels per acre, respectively, a reduction of 25·4 per cent. The difference of 11·5 per cent. between the reduction in yield of the

resistant and that of the susceptible strains was probably caused by seedling blight.

In the second experiment, carried out in 1921, resistant seed gave after virgin bluegrass [? *Poa pratensis*] 56·7 bushels per acre and after scabbed wheat 54·0, a reduction of 4·8 per cent., whilst the susceptible maize gave 52·8 and 43·4 bushels per acre, respectively, a reduction of 17·8 per cent. The difference in yield of 13 per cent. was due very likely to disease-producing organisms in the soil. These data clearly indicate that maize may suffer a significant reduction in yield when grown after a badly scabbed wheat crop.

Isolation studies indicated that *G. saubinetii* is the principal organism concerned in the production of wheat scab (98 per cent. of the cases in 1920). The reduction in yield of susceptible and resistant maize, inoculated by placing the seed in aqueous spore suspensions of the fungus for 10 minutes just before planting, averaged about 18 and 3 per cent., respectively. The results show that *G. saubinetii* is an active parasite on maize, attacking the underground parts of the seedlings and thus decreasing the stand and vigour of the crop.

A crop rotation in which wheat neither directly precedes nor follows maize seems highly advantageous for the maize-wheat belt in the United States.

MANNS (T. F.) & PHILLIPS (C. E.). **Corn root rot studies.**—*Journ. Agric. Res.*, xxvii, 12, pp. 957–964, 4 pl., 1924.

The purpose of the investigations reported upon in this paper was to determine the relative importance of the principal parasitic fungi implicated in certain diseases of maize, namely *Fusarium moniliforme*, *Gibberella saubinetii*, *Diplodia zeae*, and a fungus tentatively identified as *Cephalosporium sacchari* [suggested by Reddy and Holbert to be *C. acremoniella*: see this *Review*, iii, p. 450], several of which are known to inhibit germination and appear to be active factors in the production of stalk and ear rots [see this *Review*, iii, p. 31].

The methods followed in the determination of the nature of the infection carried in maize seed showing no external signs of disease [see this *Review*, i, p. 55], in making cultures of the fungal flora in various types of soil, and in the infection experiments (which were made under laboratory and greenhouse conditions) are detailed. Cultures from soil from a field showing much root rot failed to give any of the above-mentioned organisms, and maize seedlings grown in the laboratory on this particular soil developed better than seedlings grown on soil taken from a field which the previous year (1921) had shown no root rot. This would indicate that the root rot in the diseased field was induced by factors other than the fungi, probably by a combination of poor drainage and lack of fertility.

Of the four organisms investigated, *G. saubinetii* proved to be the most active seedling parasite of maize and may be an important factor in reducing stands. *F. moniliforme* produced but little effect on the growth of the seedlings, which, however, was considerably delayed by *D. zeae*. The fungus tentatively identified as

C. sacchari from the United States showed no pathogenicity whatever in these experiments. The organism sent by Shaw from India as *C. sacchari*, which in the authors' hands proved to be a *Fusarium* [see this *Review*, iii, p. 31], was somewhat active as a seedling parasite of maize, when used in infection work.

REYES (G. M.). **On the occurrence of Maize rust in the Philippines.**—*Philipp. Agric. Rev.*, xvii, 1, pp. 3–9, 4 pl., 1924.

The author records the collection of *Puccinia sorghi* [*P. maydis*] on maize grown at an altitude of 3,000 to 4,000 ft. in Luzon, and states that it has not been previously reported from the Philippines. The morphology and life-history of the fungus are described.

HAYES (H. K.), STAKMAN (E. C.), GRIFFEE (F.), & CHRISTENSEN (J. J.). **Reactions of selfed lines of Maize to Ustilago zeae.** —*Phytopath.*, xiv, 6, pp. 268–280, 1924.

Maize smut (*Ustilago zeae*), which sometimes does considerable damage, cannot be controlled by ordinary measures, and the breeding of resistant strains appears to offer the most promising method of combating the disease. This has been attempted by selection in self-fertilized lines under induced epidemic conditions.

Six commercial varieties were used, together with a few strains which had been selfed for approximately 10 generations. The data regarding infection were taken about tasseling time, about a month later, and (for ear infection) at maturity.

A comparison of the progeny from infected and non-infected plants, selfed in 1920, showed that it makes little difference to the progeny whether a selfed plant is infected or not. On the other hand, the susceptibility or resistance of a strain seems to be inherited as a characteristic of a strain, for infection in one generation is correlated with infection in succeeding ones, the correlation coefficients being uniformly large.

The seat of infection on the plant also seems to be hereditary in character. Thus some strains were uniformly infected at the lower ends of the stalk, others in the ear, others in the tassel, whilst some were infected in all parts.

Maize under normal conditions is in a highly heterozygous state. The ease with which strains can be isolated which differ in their reaction to smut indicates that only a few genetic factors are involved in resistance or susceptibility.

An investigation of the relation between the yield and percentage of smut infection gave correlation coefficients which were negative in each case.

F_1 crosses between resistant selfed strains proved more resistant than either parent, while F_1 crosses between resistant and susceptible strains were intermediate in their reaction to smut. Resistant strains isolated as the result of selfing may therefore be used to build up resistant varieties by crossing.

Dickson (B. T.), Summerby (R.), & Coulson (J. G.). **Smut control experiments in hull-less Oats during 1923.**—Abs. in *Phytopath.*, xiv, 7, p. 350, 1924.

Oats treated with formalin sprinkle, copper sulphate dip, no treatment, copper carbonate dust, no treatment, and copper sulphate and lime dust against smut [presumably *Ustilago avenae*] at the Macdonald College, Quebec, gave 1·8, 0·38, 72·8, 1·5, 70·0, and 1·45 per cent. of smutted heads, respectively. The copper carbonate treatment is said to be efficient in control and simple in application.

Howitt (J. E.) & Stone (R. E.). **Experiments in Oat smut control in 1923.**—Abs. in *Phytopath.*, xiv., 7, 346, 1924.

Treatment of oats by formaldehyde sprinkle, formaldehyde sprays [see this *Review*, i, p. 437], copper carbonate dust, and copper sulphate dip gave a trace, 1·2, 3·1, and 0·73 per cent. of smut [presumably *Ustilago avenae*], respectively, whilst the control gave 4·4 per cent. The formaldehyde sprinkle and copper sulphate dip reduced germination, while the formaldehyde spray gave the largest yield.

Clausen. **Die Dörrfleckenkrankheit im Hafer.** [Grey speck disease of Oats.]—*Deutsche landw. Presse*, li, 37, pp. 424–425, 2 figs., 1924.

Under the auspices of the Biological Institute (Berlin-Dahlem), the writer recently carried out a series of experiments in the control of grey speck of oats [see this *Review*, iii, p. 681]. In order to intensify the symptoms of the disease for experimental purposes the plots were fertilized with nitrate of soda and basic slag. In one plot which received nitrate of soda the subsequent application of potassium permanganate immediately checked the incipient symptoms of grey speck. In three plots of 4 sq. m. each, treated with (*a*) a complete fertilizer, (*b*) ditto with a subsequent application of potassium permanganate, and (*c*) nitrate of soda with a subsequent application of potassium permanganate, the yields were 2,600, 5,600, and 9,800 gm. respectively. In two other plots showing little trace of grey speck but receiving only nitrate of soda the yields were 6,950 and 8,350 gm. respectively, thereby emphasizing the stimulatory effect of potassium permanganate even in the absence of disease.

In another field the control of the disease was secured by fertilization with nitrate of soda and the application of 100 kg. of manganese sulphate per hect. at sowing time [see also this *Review*, ii, p. 403].

Kulkarni (G. S.). **Resistance of Sorghum to loose and covered smuts.**—*Phytopath.*, xiv, 6, p. 288, 1924.

Tests carried out at Poona, India, showed that the Dwarf Milo, Standard Milo, Feterita, Spur Feterita, White Milo, Sunrise Kafir, Blackhull Kafir, Red Kafir, Dawn Kafir, and Shallu varieties of sorghum gave, respectively, 0, 0, 0·2, 0, 0, 9·2, 18·1, 50·1, 40·7, and 42·1 per cent. infection with *Sphacelotheca sorghi* and 0, 0, 0·3, 0, 0, 2·05, 4·7, 13·5, 23·5, and 36·6 per cent. infection with *S. cruenta*.

These results agree with those of Reed [see this *Review*, iii, p. 85]. The author's earlier report (*Phytopath.*, xi, p. 252, 1921) that Dwarf Milo was susceptible was due to an erroneous identification of the host.

WESTON (W. H.). **Nocturnal production of conidia by Sclerospora graminicola.**—*Journ. Agric. Res.*, xxvii, 10, pp. 771–784, 2 pl., 1 fig., 1924.

The author describes and illustrates in detail the formation of the conidial stage, which only occurs at night but may continue nightly during a considerable part of the host's life, in *Sclerospora graminicola* on *Setaria italica*. In all essential respects the process agrees with that in *S. philippinensis* and *S. spontanea* [see this *Review*, ii, p. 359], especially in its regularity in regard to the onset of nocturnal dews. The facts that conidia are only produced at night, that during the day only remnants of the previous night's crop are found, and that the spores and conidiophores do not survive desiccation, explain why so little concerning the conidial stage of *S. graminicola* was hitherto known. Studied under optimum conditions the conidiophores were found to be much larger and more complexly branched than previously recorded.

REED (G. B.). **A bakery infection with Monilia sitophila.**—Abs. in *Phytopath.*, xiv, 7, p. 346, 1924.

Bread from a bakery in eastern Ontario, when kept 4 or 5 days, developed a shell-pink colour throughout, due to infection with *Monilia sitophila*. Disinfection of the bakery and the destruction of all infected material controlled the outbreak.

CARNE (W. M.). **A new disease of Citrus trees.**—*Fruit World of Australasia*, xxv, 5, pp. 227–228, 1924.

During investigations of brown rot of citrus (*Pythiacystis citrophthora*) carried out in Western Australia during 1923, another disease, which has provisionally been named citrus leaf blight, was discovered in association with it. This new disease causes dark, watery patches to appear on the leaves, especially towards the tips, and affected leaves curl and fall while still green. In severe attacks, especially on lemons, whole trees may be rapidly defoliated, but usually the defoliation is only partial. The twigs are killed, and frequently a strip of bark, of varying width and running from the bottom to the top of the tree on the southern side, is badly affected. Usually the lower branches suffer more than the upper ones. Fruit in the orchard has not been found to be attacked. The trees are severely checked by the disease, and the crop of the succeeding season is considerably reduced.

Leaf blight is caused apparently by a soil-living fungus belonging to the genus *Phytophthora*. The affected leaves and young twigs develop spores rapidly in wet weather, and these serve to spread the disease very quickly. So far there is no evidence that spores are formed on the blighted twigs of the previous season, and if this is so the new season's infections must begin from spores in the soil. The fungus may be distinguished from *Pythiacystis*

citrophthora by the size and shape of its spores and the development of resting spores. The disease is serious when and where brown rot is serious, but the latter differs in attacking the fruits and not the leaves.

[In a recent letter Mr. Carne states that the injury formerly attributed to *P. citrophthora* in Western Australia is all due to the new fungus.]

SUNDARARAMAN (S.). **Bud-rot of Coconuts caused by Phytophthora palmivora.**—*Agric. Journ. India,* xix, 1, pp. 84–85, 1924.

In view of the doubt expressed by Sharples [see this *Review,* i, p. 172] whether *Phytophthora palmivora* can cause typical bud rot in mature coco-nut palms, the author inoculated on 29th November 1922 two well-grown, healthy trees, about 15 years old and with stems about 12 feet high, with a sub-culture of a strain of the fungus obtained the same year from South Kanara, India. The inoculum was mixed with a few drops of sterile water, and carefully placed inside the shoot of the trees which was previously wetted with sterile water. The outer portion was covered with a mass of coco-nut fibre which was kept wet. Thirteen days after the inoculation, characteristic spots of the disease were seen on the leaves, and a week later the shoots of both trees showed signs of yellowing. On the 21st December the shoots rotted and could be easily pulled out of the crown; in the course of two months, the crowns of the two trees were blown over by the wind, leaving the trees as bare poles. Two control trees, treated on similar lines but without the inoculum, remained healthy throughout the experiment. This is regarded as clearly proving that *P. palmivora* can produce the disease on mature trees and confirms field observations on this point.

KOTTUR (G. L.). **Notes on Cotton wilt in the southern Maratha country.**—*Agric. Journ. India,* xix, 2, pp. 155–159, 1924.

Cotton wilt, generally ascribed to *Fusarium* [see this *Review,* i, p. 292], is extending in the Southern Maratha Country, Bombay Presidency, India, and steps are being taken to breed wilt-resistant types of Kumpta cotton at Dharwar in that area.

The varieties Goghari, Broach, Jari, Bani, Comilla, and Kumpta, grown on adjacent, naturally infected plots, gave 46, 32, 23, 15, 12, and 8 per cent. infection, respectively. In another test on land artificially infected, Kumpta gave 22·3 per cent. wilted plants; Dharwar 1, 38·3; Dharwar 2, 5·6; Dharwar 3, 55·1; Dharwar 4, 55·4; Dharwar 5, 72·1; Rosea, 34·5; and Wagale, 4·7. The Dharwar strains are selections from the local mixed types of Kumpta or Kumpta × Goghari. The very susceptible but otherwise highly desirable type Dharwar 1 and the strongly resistant Wagale may be taken to form the basis of further breeding work.

Seed from plants free from wilt growing in a highly infected plot of Dharwar 1 produced progeny equally susceptible with that from ordinary seed. Rozi, which is resistant in Upper Gujarat, and Bishnur Jari, a resistant type from the Central Provinces, gave 82·0 and 56·1 per cent. wilted plants, respectively, when grown at Dharwar in the specially infected plot.

Dastur (J. F.). **A preliminary account of the investigation of Cotton wilt in Central Provinces and Berar.**—*Agric. Journ. India*, xix, 3, pp. 251–260, 1924.

Cotton wilt, the most important disease of cotton in the Central Provinces and Berar, has been attributed by Butler and by Ajrekar and Bal [see this *Review*, i, p. 292] to a species of *Fusarium*. The author critically examines the evidence on which this claim is founded and calls attention to the negative results of some of the inoculations recorded by Ajrekar and Bal.

A description is given of inoculation experiments carried out with a species of *Fusarium* isolated from wilted plants, the results of which, however, were uniformly negative although the fungus grew in the tissues of seedlings which began to show loss of vitality (but no wilting). The author concludes that the parasitism of the *Fusarium* has not been established.

Micro-chemical tests (boiling in concentrated solution of logwood containing ammonium carbonate, which gives a blue colour with aluminium, and placing in an acidulated solution of potassium sulphocyanide, which gives a pink or red colour with iron) indicated the presence of aluminium and iron salts in wilted plants [see this *Review*, iii, pp. 32, 33]. No plant showed mycelium without an accumulation of aluminium and iron salts, but the latter, although not normally present in healthy plants, have been found in the absence of the fungus.

Injections of 1 per cent. solutions of salts of aluminium and iron did not produce wilting, although the sections of the injected stem were identical in appearance with those of diseased plants. Growth of cotton plants in 0·01 per cent. or more of the normal solution of aluminium chloride produced wilting and death in a week.

The author suggests that the *Fusarium* may be merely a contributory factor in the causation of the disease and that it only attacks plants in the tissues of which aluminium and iron have accumulated.

Tengwall (T. Å.). **Ueber einige parasitische Pilze auf kultivierten Rhododendren.** [Some parasitic fungi on cultivated Rhododendrons.]—*Meded. Phytopath. Lab. 'Willie Commelin Scholten', Baarn (Holland)*, vi, pp. 58–61, 3 figs., 1924.

Twigs of a cultivated *Rhododendron* (probably *R. ponticum*) submitted for examination in 1921 were found to be attacked by *Pestalozzia guepini*, but the condition of the leaves also suggested the presence of some other parasite.

Fragments of sterilized *Rhododendron* leaves, placed on cherry agar in Petri dishes, soon produced mycelia belonging to two different fungi, one being hyaline and the other almost black. The former remained sterile for a long time but eventually developed the conidia of *P. guepini*. Inoculation experiments on *Rhododendron* leaves gave positive results.

The dark mycelium rapidly produced pycnidia, which agreed with those of *Phyllosticta rhododendricola* Brun. The average dimensions of 200 conidia were 7·5 by 2 μ as compared with 8 to 10 by 3 μ given in the original description. Inoculation tests on healthy leaves gave positive results.

In the course of re-isolation experiments the author detected in some of the pycnidia on the inoculated leaves spores measuring 10 to 12 by 8 μ and agreeing with those of *Phyllosticta maximi* Ell. et Ev. The presence of the two types of conidia in one and the same pycnidium indicate that both belong to a single fungus, for which the name *P. maximi* is retained on grounds of priority, a supplementary Latin diagnosis being given. *P. berolinensis* P. Henn. is stated to be another synonym for this fungus. A new species of *Venturia*, with ascospores measuring 15 by 3·5 μ, which is named *V. rhododendri* and of which a Latin diagnosis is given, was also found on the spots. The *Venturia* is regarded as the perfect stage of *P. maximi*.

MAINS (E. B.). **Notes on the life-history of the Snapdragon rust, Puccinia antirrhini Diet. & Holw.**—*Phytopath.*, xiv, 6, pp. 281–287, 1924.

Antirrhinum rust (*Puccinia antirrhini*) is only known in its uredospore and teleutospore stages, and germination of the latter has only once been recorded previously. In an investigation of the propagation and biology of the rust carried out by the author during the past five years, germination was obtained in 5 out of 7 collections studied. The material was gathered during the summer, placed in a coarse cheese-cloth bag, and hung outside to winter. The tests were made at various times in the winter and spring in hanging drops left overnight in the greenhouse at temperatures varying from 10° to 20° C. In some seasons and in some localities, teleutospores, which are not usually produced so freely as the uredospores, occur in great numbers, and most vigorous germination took place in teleutospores from such material. In one case, teleutospores which germinated well on 14th December 1920 gave no germination when tested on the following 19th April. Inoculations of *Antirrhinum* plants with germinating teleutosposes did not give infection in any case, indicating that the rust is heteroecious, and has pycnidia and aecidia on an alternate host. It is considered that the most likely method of obtaining clues to this host is by observation of the native susceptible species of *Antirrhinum* in California, where the rust was first discovered.

PEYRONEL (B.). **Sopra un caso di nanismo e di deperimento del Lupino in seguito a concimazione con calciocianamide.** [On a case of nanism and dying-off of the Lupin caused by fertilization with calcium cyanamide.]—*Boll. mensile R. Staz. Pat. Veg.*, v, 1–6, pp. 20–26, 1924.

In a vineyard situated on the slopes and over the flat top of a small hill, lupins grown for green manure were found to be either dead or badly stunted (stalks at the most 20 cm. high and spindling, entirely defoliated but for a small bunch of chlorotic leaves at the top) on all the flat portions of the hill and at the base, where the soil had been treated with chemical fertilizers at the rate of 200 kg. superphosphate, 200 kg. calcium sulphate, and 75 kg. calcium cyanamide to the hectare. The plants growing in immediate proximity but in untreated soil, and those on the slopes of the hill both in treated and untreated soil, were quite healthy and vigorous

(stalks 50 cm. high, thick, with luxuriant foliage). The roots and the underground part of the stem of the stunted plants were heavily infected by *Thielavia basicola* and to a lesser degree by a *Rhizoctonia* and other undetermined fungi, but the same organisms were also present on the roots of the healthy plants, to which they did not appear to do any appreciable injury.

The primary cause of the trouble is believed to be the calcium cyanamide, lupins being well known to be calcifuge [see this *Review*, i, p. 445]. On the flat portions of the hill the cyanamide was not leached out by the rain water as rapidly as on the slopes. The infection by *Thielavia basicola* and other fungi is regarded as resulting from the weakened state of the seedlings caused by the fertilizer.

[Thomas (P. H.).] **The powdery mildew of the Apple, Podosphaera oxyacantha.**—*Fruit World of Australasia*, xxv, 3, pp. 121–122, 1924.

The spread of powdery mildew of apples (*Podosphaera oxyacantha*) has increased during recent seasons in Tasmania. Cleopatra, Cox's Orange Pippin, Jonathan, and French Crab are very susceptible varieties, the leaves and buds being attacked so severely as sometimes to result in almost total defoliation.

Treatment consists of the application of sulphur dust, atomic sulphur, or lime-sulphur and iron sulphide mixture. The latter is prepared by dissolving 3 lb. iron sulphate crystals in 5 galls. water and stirring this solution into 45 galls. lime-sulphur (1 in 45). A black precipitate quickly settles to the bottom of the containing vessel, and to avoid uneven application the spray must be well agitated. The first spray should be applied when the buds commence to unfold and others should be given as required. During pruning operations a small satchel should be carried, in which all affected growth should be collected for subsequent burning.

Rhoads (A. S.). **Apple measles, with special reference to the comparative susceptibility and resistance of Apple varieties to this disease in Missouri.**—*Phytopath.*, xiv, 7, pp. 289–314, 2 pl., 1 fig., 1924.

An obscure bark disease of apple trees, which has been termed measles, pimple canker, rough- or scurfy-bark canker, and pimple disease, is gradually attracting an increasing amount of attention in the United States, where it was first observed in 1908.

The symptoms are extremely variable and may be classified as the isolated pustular type, the aggregate-pustular or scurfy type, and the canker type. In the first-named, reddish to chestnut-brown pustules, superficially resembling pycnidia, may occur on the smooth bark of young branches, particularly on the York Imperial variety. They do not usually extend very deeply, never more than about half-way into the cambium. In the aggregate-pustular type of the disease the pustules become so numerous that large areas of the bark have a finely pustular appearance and the bark itself becomes irregularly thickened. This type is much more prevalent than the former. After a time, the densely pustular bark begins to crack or peel off. Cankers occur very frequently on the smooth

bark of affected trees as more or less localized areas of densely pustular bark, which soon become roughened and scaly and have sharply defined margins. Many gradations are to be found between these arbitrarily distinguished types.

Microscopical examination shows that the normal protective cork layer broadens locally in the region of the measle pustule. In fairly well developed pustules there is a transition to larger, elliptical cells not arranged in radially disposed rows. The cells at the centres of the pustules are thin-walled and take cellulose stains readily. Eventually a cork layer develops beneath the tissues of the excrescences, which then become isolated and may be exfoliated. In the scurfy type, the features are similar, but large areas of bark may become excluded. Cases of measles with lumpy rather than pustular bark show large numbers of pustules overgrown and remaining behind as inclusions in the cortex.

There are marked differences in the susceptibility of the different varieties of apple. Beach, King David, Winter Pearmain, and Summer Champion are amongst those especially susceptible to the scurfy type and Heiges to the canker type of the disease, whilst Gold, Grimes, Oliver, and most of the true crab-apples appear to be very resistant. Young York Imperial trees are very susceptible, but the older ones less so.

The cause of the symptoms, which are manifestations of a reaction of the bark to internal disturbances of the equilibrium, appears to be purely physiological. Drainage of the soil, the application of fertilizers, tillage, the use of cover crops, or the method of pruning have not been found to affect the prevalence of measles.

As a general rule the disease does not appear to be of any great consequence to the health of the tree, and many young trees ultimately outgrow it without treatment.

JEHLE (R. H.). **Reasons for lack of control of scab in sprayed Apple orchards in Maryland.**—*Rept. 26th Ann. Meet. Maryland State Hort. Soc. 1923*, pp. 183–189, 1923. [Received 1924.]

The reasons for failure of the control measures adopted against apple scab [*Venturia inaequalis*] in Maryland are grouped under four headings, namely, (1) trees too close together; (2) careless spraying operations; (3) failure to spray at the right time; and (4) use of materials which fail to control.

With regard to (1) the trees should be set at least 36 ft. apart each way, except in the case of upright varieties like Yellow Transparent, and peach and apple fillers, if used, should be removed before the commencement of the spraying operations.

Under (2) are included such practices as spraying only with the wind, neglecting to spray the under side of the foliage and fruit, unduly rapid spraying, and the use of defective equipment. A pressure of 150 to 200 lb. for spray rods and 200 to 300 lb. for guns is recommended.

In respect of (3), the most important applications for the control of apple scab are the delayed dormant, the pre-pink or pink, and the calyx. Spraying should always be carried out before rainy periods.

Unsuitable materials mentioned under (4) include self-boiled lime-sulphur, atomic sulphur, dry-mix [sulphur-lime: see this *Review*, ii, p. 506], and sulco V–B. It is further emphasized that weak concentrations of lime-sulphur (less than 1 in 40) are ineffectual.

ZELLER (S. M.). **Sphaeropsis malorum and Myxosporium corticola on Apple and Pear in Oregon.**—*Phytopath.*, xiv, 7, pp. 329–333, 1924.

Apple rot in Oregon has been known to be caused by a hyaline-spored fungus of the *Macrophoma* type, but some doubt has existed as to its identity with the true black rot caused by *Sphaeropsis malorum* [*Physalospora cydoniae*]. The disease is usually found as a bark canker under Oregon conditions. The pycnidial form of fruiting occurs more abundantly on apple than on pear, and seldom matures further than the *Macrophoma* stage, although discharged spores on the bark surrounding the pycnidia become brownish and usually septate. No true *Diplodia* pycnidia have been found. The disease is also endemic as a leaf spot in Oregon, chiefly confined to old, neglected orchards, although occasional outbreaks occur in individual orchards under favourable conditions. It shows typical 'frog-eye' symptoms, but the pycnidia seldom mature on the leaves. Black rot of the fruit also occurs rather frequently. Cultural experiments have now shown that all these types are due to *Sphaeropsis malorum*.

The economic importance of black rot in Oregon is limited by the dry summer climate, and the doubt as to its occurrence is due to the development of the pycnidia being usually arrested before they have formed typical spores.

Myxosporium corticolum occurs in a limited region as a superficial bark canker, more often on the pear than on the apple. It has no lasting effect on the trees and does not apparently attack the fruit.

BRITON-JONES (H. R.). **Pear leaf blister (Taphrina bullata Tul.)**—*Ann. Rept. Agric. & Hort. Res. Stat., Long Ashton, Bristol, for 1923*, pp. 89–90, 1 fig., 1924.

The usually infrequent pear leaf blister caused by *Taphrina bullata* was fairly common in many places in the west of England in the summer of 1923. By itself the disease is not important, its main danger consisting in that, as was clearly evident from the author's observations, it prepares the ground for the invasion by the far more serious pear scab organism (*Venturia pirina*). The most severely attacked variety at Long Ashton was Beurré d'Amanlis. Pear leaf blister should be amenable to spraying with the summer strength of lime-sulphur used against scab, namely 1 gallon of the concentrated solution to 29 gallons of water.

MOORE (W. D.). **Spraying experiments for the control of the Cherry leaf spot (Cylindrosporium padi Karst.)**—*Forty-third Ann. Rept. New Jersey Agric. Exper. Stat. for the year ending June 30, 1922*, pp. 569–572, 2 pl., 1923. [Received 1924.]

Good control of leaf spot of cherries (*Cylindrosporium padi*)

was obtained in two years' experiments by three applications of lime-sulphur, 1 in 40, at intervals of three weeks, beginning as soon as the fruit was picked. In addition to these applications the spring treatment should comprise two sprayings with lime-sulphur, one to be given when the petals fall and the other when the fruit is well formed.

BERKELEY (G. H.) & JACKSON (A. B.). **Strawberry black root.**—Abs. in *Phytopath.*, xiv, 7, p. 348, 1924.

During 1923, strawberry black root occurred fairly generally in one or two districts of the Niagara Peninsula, Ontario. The disease has hitherto been attributed to winter injury, but there is evidence, supported by inoculation tests, to indicate that at least one of the three types of injury included under black root may be caused by soil bacteria.

BERKELEY (G. H.) & JACKSON (A. B.). **Blue stem of red and black Raspberry.**—Abs. in *Phytopath.*, xiv, 7, pp. 347–348, 1924.

Blue stem, reported in 1922 on black raspberries in the Niagara Peninsula, Ontario, is now prevalent on both black and red raspberries throughout that area [see this *Review*, iii, p. 442]. Three-fourths of the Cuthbert plantations are affected and the incidence may be as high as 10 per cent. *Acrostalagmus caulophagus* was isolated from the infected canes.

STEVENS (N. E.) & JENKINS (ANNA E.). **Occurrence of the Currant cane blight fungus on other hosts.**—*Journ. Agric. Res.*, xxvii, 11, pp. 837–844, 2 pl., 1 fig., 1924.

Cane blight of currants, caused by *Botryosphaeria ribis* [see Grossenbacher & Duggar, *New York (Geneva) Agric. Exper. Stat. Tech. Bull.* 18, 1911) now occurs in Massachusetts, Connecticut, New York, Ohio, Pennsylvania, New Jersey, Maryland, and Virginia, but is less severe in the northern portions of this region and has not been found to be serious in New England or Canada.

The chief feature of the disease is the sudden wilting of the leaves and fruit, which occurs most often when the fruit is maturing, owing to the girdling of the stem by the parasite. Infection generally occurs through a terminal or lateral bud, and the parasite develops basipetally; it invades all wood structures and gives the wood and pith a peculiar blackened appearance.

In the autumn of 1921 apparently healthy fruits of a horse chestnut (*Aesculus hippocastanum*), growing near infected currant bushes, were collected in New York, and on incubation they became covered with pycnidia of *B. ribis*. The fungus was isolated and exhibited the chromogenesis characteristic of this species in culture. Inoculations on currant were successful in 19 out of 30 cases.

In October 1922, diseased canes of *Rosa setipoda* from Maryland showed pycnidia fruiting on the stems, which were severely cankered. Isolations gave characteristic chromogenic cultures of *B. ribis*, and inoculations with this fungus on currants were successful in more than half the cases. Inoculations on the Columbia

(Hybrid Tea) rose also resulted in the production of the disease. The parasite has also been discovered on *Rosa pratincola* and several varieties of cultivated roses. On the rose, however, the entire cane may not be blighted and the lesions occur as cankers on the stem. Small, pimple-like fruiting bodies of the fungus are distributed over the brown cankered bark, and the diseased canes may become so swollen that the bark splits longitudinally.

The identity of the fungus from the three hosts was established by comparisons of the perithecial stage, which developed on the inoculated plants. The size of the stroma is apparently directly affected by the thickness of the bark in which it develops, being smaller in thin bark than in thick, and uniformly smaller on the rose than on the currant.

ADAM (D. B.). **Soft fruits storage experiments.**—*Fruit World of Australasia*, xxv, 2, pp. 73–74, 1924.

In continuation of previous work [see this *Review*, iii, p. 41], experiments were conducted in 1923 on the cool storage of pears, peaches, and plums under different conditions.

Pears of the variety William Bon Chrétien were received from various places, between 30th January and 28th February, the fruit being packed in wood wool but with different wrapping papers. Whilst little difference manifested itself over a 3 months' storage period between early and later picked fruit, a very striking difference was noticeable soon after removal from storage. The skin of the earlier picked fruit turned black in patches, particularly about the stalk end, and this condition has been termed 'pear scald', although it is apparently quite different in its causation from apple scald. Pears plucked too early also showed after 4 months' storage a rapid breakdown of the flesh, in contrast with the comparative soundness of fruit picked three weeks later, namely on 24th February, a time which proved to be the most satisfactory. The best time to pick for cool storage is strictly limited in any one district; fruit gathered too late ripens too quickly. A temperature of 31° to 32° F. gave the best results. Of the various wrappers tried, a single sulphite tissue paper proved most satisfactory. Wrapping hindered cooling but prevented wilting slightly and improved the appearance of the fruit on removal from store.

Several varieties of peaches were tested. In cold store peaches generally deteriorate by becoming dry, spongy, and flavourless, or by becoming mouldy. Sponginess is a characteristic of immaturity, and mouldiness of over-ripe fruit; the former may be due not to loss of moisture but rather to changes causing gelation in the individual cells of the fruit. Picking at the correct time, when the fruit is about to soften, is probably the most important factor in peach storage. Great care should be taken to eliminate fruit attacked by *Sclerotinia cinerea*, as this fungus develops rapidly in cold store.

In the plum experiments storing at different maturities made no appreciable difference to the general softening and apparent dryness which progressed steadily throughout the storage period. The softening was accompanied by wilting, and subsequently moulds developed. A temperature of 32° was slightly better than 34° F.

Jefferson plums remained firm after two months' storage, but no variety gave a really first-class product after this time.

SARTORY (A.) & SARTORY (R.). **Action du bichromate de potassium et du bichromate de cuivre sur la croissance du Phytophthora infestans.** [Action of potassium bichromate and copper bichromate on the growth of *Phytophthora infestans.*]—*Comptes Rendus Acad. des Sciences,* clxxix, 1, pp. 69–70, 1924.

In continuation of their previous investigations [see this *Review,* iii, p. 670] the authors found that the growth of *Phytophthora infestans* on oat-malt agar at 27° C. was totally inhibited by the addition of 0·002 gm. of copper bichromate per l., while in cultures of the same strain of the fungus in the presence of 0·005 gm. of potassium bichromate, some growth was still apparent. In general it was found that copper bichromate exercised a delaying power equal to twice that of potassium bichromate at the same dose on the growth of the organism.

LINDFORS (T.). **Studier över fusarioser. III. De senaste årens försök med betning mot snömögel.** [Studies on *Fusarium* diseases. III. Recent experiments in the control of the snow mould by disinfection.]—*Kungl. Landtbr. Akad. Handl. och Tidskr.,* lxiii, 2, pp. 211–223, 1924.

After a brief review of the work carried out by German investigators on the control of the snow mould of rye [*Calonectria graminicola*] from 1917 to 1922, the author describes his own experiments from 1919 to 1923.

In the winter of 1919–20 a controlled test of the following treatments was made: immersion for 15 minutes in 0·1 per cent. corrosive sublimate; immersion for one hour in 0·25 per cent. uspulun; immersion for 15 minutes in 1 per cent. copper sulphate. Each method of treatment was represented by three plots of 45 sq. m. The resulting average number of plants in the copper sulphate plots was 323, in the corrosive sublimate plots 376, in the uspulun plots 385, and in the untreated plots 100. The corresponding grain yields were as follows: copper sulphate 107·5 gm.; corrosive sublimate 113·2 gm., uspulun 117·3 gm.; untreated 110 gm.

In 1920 the seed was treated as follows: immersion for one hour in 0·25 per cent. uspulun; sprinkling and shovelling with 0·25 per cent. uspulun; immersion for 15 minutes in 1 per cent. copper sulphate; control. The average number of plants in the sprinkled uspulun plots was 142; in those from seed immersed in uspulun 174; in the copper sulphate plots 143; and in the untreated 100. The corresponding increase of yield over the untreated seed in the plots from seed immersed in uspulun was $16 \cdot 9 \pm 3 \cdot 00$ gm., as compared with $9 \cdot 6 \pm 2 \cdot 23$ gm. for the sprinkled plots and $9 \cdot 7 \pm 2 \cdot 27$ gm. for those treated with copper sulphate.

The results of three years' tests indicated that the reduction in the strength of the concentration of uspulun or corrosive sublimate in consequence of the repeated use of the same solution (a reduction which could be detected by quantitative analysis) did not appreciably affect the efficacy of the treatment.

In 1922–23 comparative tests were carried out with formaldehyde 0·15 per cent., immersion for 20 minutes and rinsing for 5 minutes; ditto, 0·25 per cent.; and sprinkling with fusariol, germisan, and uspulun. No improvement was effected by the lower concentration of formaldehyde and only a slight increase in yield obtained by the higher one; this method must by regarded as totally unsuitable for the control of the snow mould. Germisan and uspulun increased the number of plants from $44{\cdot}8 \pm 1{\cdot}60$ per cent. of the seed sown in the untreated plots to $65{\cdot}3 \pm 3{\cdot}62$ per cent. and $64{\cdot}8 \pm 2{\cdot}05$ per cent. respectively. The corresponding figure for fusariol was $51{\cdot}8 \pm 2{\cdot}71$ per cent.

In 12 out of 13 tests immersion in 0·5 per cent. uspulun led to a substantial increase in germination (up to 72 per cent.).

ERIKSSON (J.). **Phytopathologische Mitteilungen. I.** [Phytopathological notes. I.]—Reprinted from *Arkiv för Bot.*, xix, 6, 29 pp., 12 figs., 1924.

(1) Bean anthracnose (*Colletotrichum lindemuthianum* (Sacc. & Magn.) Briosi & Cav.). In 1912 the author examined a number of beans from a consignment of seed which had yielded plants severely affected by anthracnose (*C. lindemuthianum*). Only on one bean out of 80 were there any external evidences of the disease, in the shape of a few minute pustules on the surface. Microscopic examination of sections of the suspected beans also failed to reveal any trace of spores or mycelium in the interior. In the following summer a number of these beans were planted at the Stockholm Experiment Station simultaneously with two other plots containing beans of a different origin, one situated 10 m. away from the suspected plot and the other midway between the two. After more than a week's growth, pustules of the fungus were apparent on the cotyledons in the first plot and in about two months from planting the beans in this plot were heavily diseased, those in the plot 10 m. distant being quite healthy and those in the intermediate plot showing only slight traces of infection.

It is concluded from these results that the source of the disease in the heavily infected plot was a latent germ in the interior of the seed, and that the conidia-forming pustules on the surface of the cotyledons had only a limited range (not extending beyond 5 to 10 m.) of infection.

The investigations of other workers in connexion with the disease are briefly discussed and the author's mycoplasm theory recapitulated with special reference to the case in point, which it is believed to explain.

Anthracnose of beans is stated to have occurred very severely in Sweden during the period 1912 to 1916, and legal measures had to be taken at one time to prevent the sale of infected consignments in the public markets and elsewhere.

(2) Bean rust (*Uromyces appendiculatus* (Pers.) Link.). In 1910 and 1920 the author investigated epidemics of rust on beans in the south of Sweden. The disease made its first appearance relatively late in the season (about 10th August) when the plants had already attained maturity. Aecidia were then evenly distributed over the

entire lower surface of the leaves, followed in two to six days by uredo- and teleutospores. About a month later, when the affected leaves were covered with black spore masses and some had already fallen, the fungus was also observed on a few pods.

Three peculiarities of *U. appendiculatus* are pointed out and briefly discussed, namely, the comparatively infrequent formation of aecidia, which is stated to occur either very early or late in the season, the belated occurrence of the epidemics, believed by the author to be correlated with the development of the fungus, whether in the form of mycelium or of mycoplasm, within the tissues of the host; and the varying degree of resistance to the disease among individuals of admittedly susceptible varieties, considered to be influenced by the date of sowing. The occurrence of the August epidemics on the earliest-sown plots is considered to point to the transmission of the disease by the seed.

(3) Beet mildew (*Peronospora schachtii* Kühn). In the summer of 1921, and again in 1922, the author observed one isolated sugar beet plant infected by mildew in the midst of a perfectly healthy crop on the same estate near Malmö. The occurrence of the disease on one individual only points to the transmission of the causal organism by the seed. The infective capacity of the conidia formed during the summer would appear to be very slight, unless it be assumed that a new biological strain of the fungus, restricted to the particular individual in question, is in course of evolution.

(4) Apple fusariose (*Fusarium willkommii* Lindau). In May 1913 the author received for examination a number of one-year-old apple twigs from the west of Sweden with swollen, discoloured nodes, from several of which the buds and leaves had already dropped. The numerous, greyish-white spore-cushions covering the affected area contained conidia agreeing well with those of *F. willkommii* [see this *Review*, ii, pp. 90, 218].

This is believed to be the first record of the disease on such young twigs and may be of some importance in view of the possible control, in the incipient stages, of later attacks of *Nectria galligena*.

BABOWITZ (K.). **Ratgeber zur Sortenwahl. Vorprüfungsergebnisse mit Sommerweizen, Hafer, Erbsen, Feldbohnen, Futterrüben. Versuchsjahr 1920–22.** [Advice on varietal selection. Results of preliminary tests with summer Wheat, Oats, Peas, field Beans, and fodder Beets. Experimental years 1920–22.]—*Arb. Deutsch. Landw.-Gesellsch.* 327, 90 pp., 1924.

These experiments were conducted on similar lines to those described in a previous report [see this *Review*, iii, p. 203].

Of the 14 summer wheats tested Breustedt's Japhet was particularly susceptible to loose smut [*Ustilago tritici*]. Breustedt's and Mahndorfer Bordeaux, Rimpau's and Strube's Roter Schlanstedter, and Goetze's Kalksteiner were more resistant.

Of the 16 varieties of oats tested on heavy and medium soils, Sperling's Sinslebener, Edler's Göttinger, and Carsten's III were highly susceptible to loose smut [*U. avenae*]; while the same was

true of Bohnstedt's Benauer and, to some extent, of Mette's Ligowo and Fischer's Wirchenblatter XVI, all adapted to light soils.

The Viktoria and Folger varieties of peas were attacked by foot rot [cause not specified], but on the whole the incidence of fungous diseases in this crop, as well as in beans and beets, was negligible.

FRYER (J. C. F.) & PETHYBRIDGE (G. H.). **The Phytopathological Service of England and Wales.**—*Journ. Min. Agric.*, xxxi, 4, pp. 331–340, 1924.

After a brief account of its origin and development, the authors describe the present position of the Phytopathological Service in England and Wales. It consists of two main sections, namely: (*a*) the official side attached to and controlled directly by the Ministry of Agriculture, and (*b*) the non-official side attached to various universities, agricultural colleges, and research institutions. The official side is divided into three units: (1) The Pathological Laboratory at Harpenden, with a small entomological and mycological staff, the main function of which is the provision of a scientific basis for the Orders issued under the Destructive Insects and Pests Acts, and for all other special work connected with legislation of this type; this unit is also in charge of the intelligence system, i. e., the collection and distribution of information on the spread and depredations of pests and diseases, and acts as the co-ordinating centre for the whole service. (2) An administrative unit, forming an integral part of the Horticultural Division of the Ministry in London. (3) The Ministry's Inspectorate, about 30 members of which have special qualifications in regard to plant pests and diseases. The two latter bodies carry out in the field the practical work of administering the existing phytopathological legislation, and also provide, in co-operation with the Laboratory at Harpenden, for the very extensive work required for the inspection and issue of health certificates for consignments of plants going abroad and for the control of plants imported into the country.

Section (*b*) is financed largely from Government funds, but, while subject to a certain amount of supervision, is free from detailed control by the Ministry. It consists of (1) the Phytopathological Research Institute at the Rothamsted Experimental Station, Harpenden, and scientific workers attached to specialized research stations such as the Long Ashton Research Station, Bristol; the Imperial College of Science, London; the Research Station at East Malling; the Lea Valley Station, Cheshunt; and the Department of Helminthology of the London School of Tropical Medicine; and (2) the corps of advisers, consisting of an entomologist and mycologist in each of the agricultural provinces, fourteen in number.

Each part of the service [a detailed list of the personnel of which is given] has its own sphere of operations in which it carries out its own routine work; at the same time co-operation is continuous between the various branches.

DICKSON (B. T.). **Mosaic studies. IV.**—Abs. in *Phytopath.*, xiv, 7, p. 346, 1924.

The mosaic of *Pisum sativum* was transmitted through the seed

to Prussian Blue, Golden Vine, Canadian Beauty, Chancellor, and White Marrowfat varieties of peas at Macdonald College, Quebec. The transmission of tomato mosaic to healthy tomato was effected by the flea beetle (*Epitrix cucumeris*) in one experiment in 1923. Soy-bean mosaic was found for the first time in Quebec.

TENGWALL (T. Å.). **Ueber einen bisher unbekannten Fall von Symbiose von Algen und Pilzen.** [A hitherto unknown case of symbiosis of algae and fungi.]—*Meded. Phytopath. Lab. 'Willie Commelin Scholten', Baarn (Holland)*, vi, pp. 52–57, 4 figs., 1924.

Having observed the frequent association of algae (especially *Protococcus viridis*) with fungi (chiefly *Dematium pullulans* and *Cladosporium herbarum*) in the sooty moulds occurring on the leaves of various evergreen shrubs and conifers, the author undertook a series of experiments to ascertain the nature of the relationship.

Twigs of *Rhododendron ponticum* and *Ilex aquifolium* were washed first with soap and water, then with a dilute solution of corrosive sublimate, and rinsed. A thin layer of an algal culture (*Chlorella vulgaris*), together with numerous conidia of *D. pullulans* and *C. herbarum*, was spread over some of the leaves, while others were covered with conidia only. The branches were placed in water under bell jars. When examined a week later, the fungous mycelium was found to have developed extensively in the layer formed by the algal cells both on *Rhododendron* and *Ilex*. The hyphae were often covered with algae throughout their length. Conidia were produced in large numbers, especially on *Ilex*. On the leaves without algae there was a relatively sparse formation of conidia, minute fragments of mycelium being also detected. A similar combination of alga and fungus was observed on a silicate substratum without any addition of nutrient substances.

The results of these synthetic experiments are regarded as proof of a symbiotic relation between the algae and fungi (in which the latter derive the principal, if not the only, benefit) in the sooty moulds. The fungus undoubtedly takes up carbohydrates (in the form of starch) from the alga, but there is no question of parasitism. Nitrogen is probably supplied to both partners by the dust which settles on the leaves. The sole advantage which may possibly accrue to the alga from this form of symbiosis is that the fungal hyphae may serve to bind together the algal layers.

The views of other workers on symbiosis are briefly discussed.

CLEMENT (E.). **Germination of Odontoglossum and other seed without fungal aid.**—*Orchid Rev.*, xxxii, 374, pp. 233–238, 2 figs., 1924.

It was demonstrated by a series of experiments [particulars of which are given] that a high percentage of *Odontoglossum, Dendrobium, Cattleya,* and *Cymbidium* seed can be germinated aseptically in a specially prepared medium [the composition of which is not indicated] and normal growth maintained after the transfer from the medium to pots [see this *Review*, iii, p. 359]. Seed obtained from different pods varied considerably in vitality; pro-

tracted storage in paper may be detrimental to the embryo, owing to evaporation or desiccation of the oily food contents. The germination of fresh seed in a suitable medium is stated to be a very rapid process, the seedlings requiring no attention during their subsequent development except for the maintenance of the correct temperature. They may be removed to compost in pots at an early stage of root formation with little or no loss of life.

PRATT (CLARA A.). **The staling of fungal cultures. I. General and chemical investigation of staling by Fusarium.**—*Ann. of Botany*, xxxviii, 151, pp. 563–595, 1 graph, 1924.

After a survey of literature on the staling of fungus cultures [see this *Review*, ii, p. 328; iii, p. 542] the writer describes in considerable detail her own experiments with a species of *Fusarium*, which was grown in Richards's solution, the staleness being gauged by the length of *Botrytis* germ-tubes from spores sown in drops of the filtered medium.

Exhaustion of food was found to be of secondary importance, *Botrytis* being capable of growth in dilutions of the stale medium, and a sufficient percentage of sucrose remaining after three months to admit of good development of the germ-tubes.

Boiling was found to effect partial restoration of a stale medium in acid cultures, while acidification produced a partial improvement in older alkaline cultures. The result of acidifying and boiling the same liquid was greater than the sum of these two separately. Staling is not considered to be due to an enzyme which is reactivated by heating. Extraction with ether after (but not before) acidification removes the staleness, and this is believed to point to the absence of free organic nitrogen bases, and to the presence of the salts of organic acids in the alkaline medium. Staleness was not removed by oxidation of the medium with hydrogen peroxide and gaseous oxygen. Charcoal was able to absorb considerable quantities of the toxic substances, but only on the removal of alkalinity. Treatment with colloidal clay ('collosan') gave growth nearly equal to the control, irrespective of whether the liquid was acidified before or after the process.

The results of chemical tests indicated the formation by *Fusarium*, on Richards's solution, of ammonia, small quantities of alcohol and of salts of acetic, propionic, valeric, and lactic acids, and, possibly, traces of aldehydes and formaldehyde. The amount of free ammonia is small, but fairly large quantities of ammonia are formed, as is shown by the presence in the stale culture of large crystals of magnesium ammonium phosphate. An increase of alkalinity, not due to the formation of ammonium compounds, followed the boiling of the alkaline stale medium.

The growth of *Botrytis* spores was shown to be affected by the addition to the fresh medium of various organic compounds occurring in the stale medium. Alcohols and acetaldehyde, being toxic only at high concentrations, can play but a negligible part in staling. Benzoic and salicylic acids are toxic, even after the addition of sodium hydroxide sufficient to bring the P_H value to 4·6, at much lower concentrations than any of the fatty acids. Of the latter, propionic and butyric acids are effective at lower con-

centrations than acetic acid; but even this acid greatly reduces the mean germ-tube length at a relatively low concentration and is somewhat more toxic than oxalic acid; the introduction of a hydroxyl into the acid radicle appears greatly to reduce its toxicity.

The ester test indicated the presence of organic acids in the stale medium, probably at an acid radicle strength approximating N/50, which is more than enough to lead to considerable reduction in growth.

The general conclusion from these tests is that organic acids of the fatty acid series are sufficiently toxic to explain the reduced growth of *Botrytis* spores which takes place on a medium that has been used for the cultivation of *Fusarium* even after acidifying the medium. The results obtained were not due to increased acidity, since this only ranged from P_H 4·6 to 3·3, at which values germination and growth of *Botrytis* are not greatly affected.

SCHAPOSCHNIKOW (W.) & MANTEIFEL (A.). **Ueber die Koremienbildung bei einigen Pilzen.** [The formation of coremia in certain fungi.]—*Centralbl. für Bakt.*, Ab. 2, lxii, 13–16, pp. 295–302, 1924.

In this paper the author describes the results of culture experiments with a fungus with large coremia (up to 5 cm. in length), closely resembling *Isaria farinosa* and discovered in a vessel of which the walls were covered with calcium lactate. These coremia developed horizontally from the walls towards the centre of the vessel, and resembled the main root of a bean plant. The fungus grew readily on artificial media, but liquid substrata proved unsuitable for experimental purposes because the coremia only appeared after a year. On horizontal layers of agar media the formation of coremia was slow and uncertain, but when the layer was placed vertically they developed readily and the growth was always more or less horizontal and towards the light, so long as the media were exposed to diffuse unilateral illumination.

In order to ascertain the factors governing the horizontal growth of the coremia, culture flasks with both vertical and horizontal layers of media were placed in a dark room. Coremia were formed, approximately simultaneously, on both the vertical and horizontal surfaces (upwards as well as downwards in the latter case), growth being always vertical to the surface.

Gravity, therefore, exercises no influence on the direction in which the coremia develop. On the other hand, the effect of light was very pronounced, the coremia being always positively heliotropic in the case of unilateral illumination. In the absence of light, growth was always in a vertical direction to the surface. This vertical position may perhaps be induced by negative hydrotropism, in which case the consistency and age of the substratum would play a large part. It was observed that coremia formed more vigorously on the thinner parts of sloped media and also on media kept for a considerable time before being used.

In a series of tests in which the fungus was grown in nutrient agar with the addition of varying amounts of glucose (7, 14, 21,

and 28 per cent.), the development of the coremia occurred normally only in that receiving the smallest quantity.

The authors have recently described (*Arb. staat. chem.-pharmaz. Forschungsinst. Moskau*, v, 1923) a new species of *Penicillium*, *P. arenarium*, which develops coremia in culture on an acid medium, e.g., beerwort, in the presence of a large quantity of peptone (3 to 5 per cent.) or other source of nitrogen with an N-content up to 0·2 per cent. The optimum temperature for coremial development in this organism is 35° to 40° C. The renewal of the medium after two or three weeks produces an effect similar to that secured by the use of large quantities of nitrogen. The development of coremia in *P. arenarium* was found to be constantly associated with luxuriant growth, the suppression of conidia, and a submerged mycelium.

These investigations are regarded as indicating the necessity for further research on the apparently highly divergent factors governing the formation of coremia in different species of fungi.

LEE (BEATRICE) & PRIESTLEY (J. H.). **The plant cuticle. I. Its structure, distribution, and function.**—*Ann. of Botany*, xxxviii, 151, pp. 525–545, 12 figs., 1924.

In an earlier paper [Priestley. Suberin and cutin. *New Phytologist*, xx, 1, pp. 17–29, 1921] it was pointed out that the structure and composition of the cuticle was of special interest to plant pathologists, in view of the fact that many fungi have to traverse this layer before developing parasitic activities, and there is evidence that the passage is effected, in certain cases at least, by the exertion of direct pressure rather than by dissolving a way by enzymic action.

Cutin is not a chemical entity : it is a name for an aggregation of substances having the same general characters. These substances are largely fatty acids formed in the process of differentiation of the tissues, accumulating in the walls, and moving along the latter until they reach the surface. Unsaturated fatty acids, in the presence of oxygen, oxidize and condense to varnish-like substances insoluble in water and in fat solvents, and the film of fatty substances collecting on the surface of the epidermal cells thus becomes a rigid, impermeable layer, distinct from the cell walls over which it is deposited. Intermediate lamellae, often called cutinized layers, may be distinguished between the cellulose wall of the epidermal cells and the fatty deposit outside the latter. In these lamellae a cellulose matrix is more or less heavily impregnated with deposits of fatty substances. The cuticle itself is entirely free from cellulose, nor could the authors detect the presence of pectic substances in the outermost layer, though the cutinized lamellae, in some cases, gave a distinct pectic reaction.

As the cuticle grows older it becomes less soluble in fat solvents and loses its power of dissolving additional fat. Any further migrating fat from within is then deposited in the cutinized layers, the radial walls of the epidermal cells, or even all around the latter. Cuticular patches are sometimes formed bordering intercellular spaces (which, if dry, would permit the oxidation and condensation

of the fat) and a thin layer of fat, resembling a cuticle, also forms around the substomatal cavities.

The action of external conditions on this process may be considerable. The readiness with which the fatty substances move along the cell walls will depend partly on the state of combination of the fats, which is mainly a question of the relative solubilities of the different soaps formed by the fatty acids. Potassium, sodium, and magnesium soaps are relatively soluble, calcium soaps insoluble. Hence the thickness of the cuticle may be expected to be less when there is relatively high proportion of calcium ions as compared with the others in the soil solution. Instances are given to show that this is actually the case.

Evidence was obtained that the oxidation and probably the condensation of the fatty acids is facilitated by light, and other workers are quoted to show that the same plant grown under conditions of decreasing moisture and increasing light thickens its cuticle. Oxygen is necessary for the proper formation of the cuticle. The cuticle formed in a moist atmosphere and in etiolated plants is soft, though not necessarily thin, and is liable to show lack of resistance to internal swelling forces due to turgid tissues, a factor which may play a part in the development of intumescences. The young cuticle is relatively pervious to water vapour, but as the cuticle gets older or is dried out to the varnish-like layer already mentioned it becomes progressively less permeable. In this condition it is relatively very rigid and resistant to stretching.

Plants vary in the amount of fat they contain, and certain plants, such as those of heaths, synthesize large quantities, with the result that they form very thick cuticles.

A discussion of the chemical composition of the cuticle is reserved for a second paper.

WOFFENDEN (LETTICE M.) & PRIESTLEY (J. H.). **The toxic action of coal gas upon plants. II. The effect of coal gas upon cork and lenticel formation.**—*Ann. of Appl. Biol.*, xi, 1, pp. 42–53, 2 figs., 1924.

In continuation of the senior author's work upon the effect of traces of coal gas upon plants [see this *Review*, ii, p. 331], further experiments have revealed many cases of the failure of the Casparian strip to form in some or all of the endodermal cells in the root and etiolated stem in the presence of unsaturated gaseous hydrocarbons, and have shown that this effect is a consequence of the increased mobility of the unsaturated fatty acids within the walls of the meristematic tissues prior to the formation of the endodermis and their migration towards the plant surface. The meristem walls become more permeable and this results in a more rapid growth of some of the meristematic cells, in consequence of a freer access of water to them. Two examples are cited in which this effect was clearly distinguished, namely, etiolated seedlings of lentil (*Lens esculenta*), where swellings were developed on the poisoned shoots one or two inches above the level at which the endodermis had differentiated, and *Phaseolus multiflorus*, in etiolated seedlings of which no primary endodermis is present and shortening of the epicotyl and swelling of such shoots result when they are

poisoned. The normal green stem is indifferent to traces of coal gas because the fatty substances leave the meristem walls and accumulate in the surface wall at a very early stage of development.

The formation of cork in a normal tissue is briefly described. As the cells are cut off to the outside of the phellogen they rapidly differentiate; the wall divides into two lamellae, an outer containing pectin and fatty acid and an inner with a cellulose basis. At the same time fatty acids liberated within the protoplast diffuse into and impregnate the two lamellae, especially the inner, where they undergo oxidation and condensation to form suberin.

Experiments with stems of elder [*Sambucus nigra*] plants growing in the open showed that the effect of gassing varies with the age of the internodes. When the apex of the shoot was exposed to the gas it began to droop within a few hours and later withered. Internodes from just below the apex to the fifth below, exposed before 24th July, showed in the youngest lenticels a white proliferation in the centre surrounded by a brown margin, whilst older ones showed a brown centre with a white ring of proliferating tissue. After July 24th, no effect was produced on lenticels of the lower internodes, but the stem surface between the lenticels gradually became swollen and discoloured. Towards the end of August cork formation had occurred close up to the youngest internodes and these were the only parts affected by the gas.

The poisoning effect of gas upon cork formation is clearly produced at an early stage of the phellogen's activity. Sections of the proliferating tissue showed the proliferating cells to be cut off to the outside of the phellogen and to be practically completely unsuberized. In the case of the older stems which become swollen and discoloured, sections showed the swelling to be due to the epidermis being forced up by the action of the proliferating, unsuberized cells. The normal differentiation of the cork cells therefore is greatly modified by the presence of coal gas, and the main factor is the inability of unsaturated fats to deposit in the wall in the presence of the unsaturated hydrocarbons of coal gas.

The experimental results suggest that coal gas will not be toxic to cork-enveloped tissues except in the case of leakage from gas mains around roots of plants. The entry of pathogenic organisms will be facilitated by the proliferated unsuberized tissue.

WHITEHEAD (T.). **Potato leaf-roll and degeneration in yield.**—*Ann. of Appl. Biol.*, xi, 1, pp. 31–41, 1924.

The results are described of an investigation which has been instituted at Bangor, North Wales, of various economic aspects of leaf roll disease of potatoes. The primary symptoms of the disease have rarely been observed with certainty in North Wales, and never on the variety Arran Comrade, which was used throughout this work.

Some preliminary experiments in 1921 showed (1) that leaf roll could be communicated by grafting tubers, as stated by Quanjer; (2) that disinfection of 'seed' in 1 in 1,000 corrosive sublimate for $1\frac{1}{4}$ hours did not control the disease; and (3) that cutting diseased tubers before planting did not affect the yield.

The loss of yield from the disease in 1921, 1922, and 1923 was 55·8, 45·6, and 52·6 per cent. respectively (the tubers of the diseased stock of each year being planted as seed for the next crop), whilst stocks first infected in 1922 showed losses of 50, 44·8, 60·9, and 57·4 per cent. in 1923. These results indicate that the effects of leaf roll are not cumulative under the conditions obtaining in North Wales. Similar results have been obtained from Craibstone (north of Scotland), but figures from Leeds, with the same stocks as at Bangor, showed losses of 39·7 and 60 per cent. in 1921 and 1922, respectively.

The effect of leaf roll on the size of tubers produced was ascertained by determining the number of 'ware' and 'seed' tubers (those which do not pass through $1\frac{1}{2}''$ and $1''$ mesh, respectively), and 'chats' [smaller tubers] yielded in 1922 and 1923 from alternate rows of healthy and diseased plants. The proportion of seed size and smaller tubers in 1922 was 73·8 per cent. for diseased stock and 74·0 for healthy, and in 1923, 60·6 and 70·3 per cent. respectively. Calculated on the weight of the tubers, the figures for plants from diseased, new Scotch, and once-grown seed were 78·4, 75·3, [wanting] in 1921, 46·8, 49·7, and 38·8 in 1922, and 30, 41·1, and 29·9 in 1923. Leaf roll does not therefore appear to increase the percentage of seed and small tubers in the variety studied. The figures also support the local opinion that new Scotch seed usually gives a larger proportion of small tubers than once-grown seed.

The effect of leaf roll on the total number of tubers produced was tested in 1922 and 1923. Diseased plants in 1922 gave an average of 7·9 tubers per plant, whilst healthy gave 15, whilst in 1923 the figures were 6·2 and 15·9 tubers per plant respectively. The reduction in total number of tubers was 47·3 per cent. in 1922 and 61 per cent. in 1923.

Full details are given of experiments carried out in 1921 and 1922 on the transference of leaf roll under garden conditions. The work of the former year has already been noticed from another publication [see this *Review*, iii, p. 416]. In 1922, alternating rows of healthy and diseased seed were grown, and the progeny in 1923 showed that the disease had been transmitted to the healthy tubers, mostly by means of aerial insects, although soil transmission is believed also to have taken place.

The relation of leaf roll to seed potato production is discussed. Many exposed areas have been located in which seed of some variety has been saved for many (up to 80) years apparently without deterioration in yield. Such localities have very few potato insects and are regarded as essentially good seed potato growing districts.

Cavadas (D. S.). **Sur des tubercules de Pommes de terre attaqués par le Micrococcus prodigiosus.** [On Potato tubers attacked by *Micrococcus prodigiosus*.]—*Rev. Path. Vég. et Ent. Agric.*, xi, 1, pp. 19–20, 1924.

Potatoes sent for examination from the Department of Allier [France] were found to have been rotted in the interior by *Micrococcus* [*Bacillus*] *prodigiosus*. There was an exterior layer of

healthy tissue about 1 cm. thick, and a layer of diseased tissue of a coral-red colour about the same thickness lining a cavity which resulted from the destruction of the centre of the tuber. The discoloured layer consisted of disintegrated cells and of corroded starch granules coloured pink by the pigment produced by the organism. It was separated from the healthy tissue by a layer of suberized cells, which, however, could not have played any part in the protection of the tuber, as it was easily broken down by the enzymes secreted by the bacillus.

The author was prevented by his departure from Paris from making any further investigations on the pathogenicity of this organism on the potato.

WEISS (F.). **Deux ans d'essais de culture de quelques variétés françaises de Pomme de terre en terrain contaminé par le Synchytrium endobioticum à Freeland (Pensylvanie).** [Two years' trial of cultivating some French varieties of Potato in soil infected with *Synchytrium endobioticum* at Freeland (Pennsylvania).]—*Rev. Path. Vég. et Ent. Agric.*, xi, 1, pp. 93–98, 1924.

A list is given of some named French varieties of potatoes which, when sown in 1922 and 1923 in soil infected with *Synchytrium endobioticum* at Freeland, Pennsylvania, United States, exhibited entire immunity from the disease. In both years Chardon, Czarine, and Quarantaine de la Halle remained immune. In another list are included 12 other varieties which, under similar conditions, proved to be susceptible in varying degrees, and in a tabular summary is shown the behaviour of the French varieties to leaf curl, mosaic, crinkle, hopperburn, *Actinomyces scabies*, *Rhizoctonia*, and *Fusarium* wilt.

AYOUTANTIS (A.). **Sur la gale poudreuse de la Pomme de terre due au Spongospora subterranea (Wallr.) T. Johnson.** [On powdery scab of Potato, caused by *Spongospora subterranea* (Wallr.) T. Johnson.]—*Rev. Path. Vég. et Ent. Agric.*, xi, 1, pp. 60–66, 5 figs., 1924.

A very brief description is given of the lesions caused by *Spongospora subterranea* as observed by the author on potato tubers affected with powdery [corky] scab sent for examination from Algeria, where the disease was first recorded in 1923 [see this *Review*, ii, p. 568]. This is followed by a cursory review of the existing literature on the taxonomy of the fungus, the damage caused by it, the conditions favouring its spread, and the measures recommended for its control.

BECKER. **Zur Beizung der Pflanzkartoffeln.** [On the steeping of seed Potatoes.]—*Deutsche landw. Presse*, li, 32, p. 366, 1924.

Nine experiments in the treatment of seed potatoes (seven with Industrie, one with Erdbeer, and one with Blaue Odenwälder) were conducted in the Lübeck district of Germany in the autumn of 1923. Two hundred tubers were immersed for 30 minutes in a 0·125 per cent. solution of uspulun, 200 for 15 minutes in 0·25 per

cent. uspulun, and 400 left untreated. In almost every case the plants from the treated tubers were earlier, stronger, and of more uniform growth than the controls, while the average increase of yield from the treatment was 20 lb. per sq. rod (17·5 per cent.). The maximum increase of yield obtained was 45 lb. per sq. rod. The stronger solution gave better results throughout.

Gram (E.). **Forsøg med Bekaempelse af Kartoffelskimmel paa Kartofler og Tomater. 1917–1923.** [Experiments in the control of late blight on Potatoes and Tomatoes. 1917–1923.] —*Tidskr. for Planteavl*, xxx, 4, pp. 597–621, 1 fig., 1 diag., 1924. [English summary.]

Over 1,000 spraying experiments [details of which are given] in the control of late blight of potatoes and tomatoes (*Phytophthora infestans*) were carried out at the Lyngby (Denmark) Experiment Station during the period 1917 to 1923. The results in respect of potatoes may be summarized as follows. The increased yield due to spraying (calculated over the entire period and counting all the tests) amounted to about 13 per cent. of the total crop. To this must be added the increased size and sounder condition of the tubers and a higher percentage of dry weight and starch.

The best results were obtained with 2 per cent. Bordeaux mixture. The stronger solutions, which were dearer and less easily manipulated, were no more efficacious, while weaker ones were lacking in adhesiveness. The best treatment consisted in two (occasionally three) applications of 700–1,000 l. of the mixture per hect., of which the first should be given immediately the disease is observed. Any delay may involve a heavy loss, while premature applications are also less effectual. Large quantities of the liquid dry slowly on the plants, and this is a risk in showery weather. Spraying should not be carried out when the plants are wet with rain. One application is generally insufficient, two of 1 per cent. being better than one of 2 per cent. With one application there is the further risk that the plants may remain green and healthy-looking while in reality sufficiently diseased to infect the tubers during lifting.

Two per cent. Burgundy mixture gave slightly less satisfactory results than Bordeaux as regards yield, but the solution is easy to prepare and apply. Nosperal, stated to consist of 40 per cent. copper salts and 60 per cent. insoluble Harpix salts, gave good results with a number of varieties, but on the whole the yields were inferior to those secured by the application of Bordeaux mixture. Messing vitriol (a metal waste-product of which about two-thirds are stated to consist of copper sulphate), used instead of copper sulphate in Bordeaux mixture, gave approximately identical results with the latter as regards yield, but the formation of a deposit impeded the spraying operations. Blighty, a proprietary preparation of the Burgundy mixture type, proved efficacious on a small scale. It is readily soluble and adheres well to the plants during wet weather. Apa-Bordeaux-Green, another proprietary mixture, was also effective, though somewhat inferior to home-made Bordeaux. Uspulun, lime-sulphur, and solomia failed to control the disease to any appreciable extent.

Two applications of 50 kg. Bordeaux dust per hect. (10 kg. anhydrous copper sulphate plus 90 kg. powdered lime) resulted in a slightly lower yield than that obtained by spraying. This method is very convenient in application, but the dust is more easily washed off than the liquid mixture.

In order to derive the fullest possible benefit from spraying and prevent any risk of infection of the tubers it is advisable to postpone the lifting of the latter until 10 or 12 days after the foliage is completely withered.

Excellent results were obtained in the four years' experiments on the control of late blight in Danish Export and Lucullus tomatoes. The best yields and control of *P. infestans* on this crop were given by two applications of 2 per cent. Bordeaux mixture, but 1 per cent. Bordeaux and 1 per cent. Burgundy mixture were also very efficacious. Messing vitriol and nosperal were satisfactory (though inferior to Bordeaux mixture), but lime-sulphur and solbar had hardly any effect. Bordeaux mixture simultaneously reduced the attacks of *Ascochyta lycopersici* [*Didymella lycopersici*] on the fruit but not on the stems.

PEYRONEL (B.). **Alcune osservazioni sulla biologia della Rizottonia della Patata (Hypochnus solani Pril. & Del.).** [Some observations on the biology of *Rhizoctonia* of Potato (*Hypochnus solani* Pril. & Del.).]—*Boll. mensile R. Staz. Pat. Veg.*, v, 1–6, pp. 4–19, 2 figs., 1924.

In 1923 potato crops in the Valli Valdesi [Italy] suffered heavily from drought and the attacks of insects and fungi. Among the latter the greatest injury was done by *Vermicularia varians*, which does not appear to have been hitherto recorded in Italy but which the author believes to be not uncommon. Equally widespread was *Spondylocladium atrovirens* (silver scurf of the tubers), but this fungus did not appear to do any appreciable harm. The commonest disease, however, was that caused by *Rhizoctonia solani*, with which the present paper deals.

In the Valli Valdesi attack, the penetration of *R. solani* in the tubers was limited to the flattened corky cells of the periderm and did not produce any grave lesions. At harvest the smaller tubers, most recently formed, were found to be much more heavily infected than the older, larger ones. The lesions on the stolons and at the base of the haulms above ground were considerably more severe, but as *V. varians* was also present in most cases the specific action of the *Rhizoctonia* was difficult to establish. Of the three varieties of potatoes [unnamed] on which the disease was studied, two were in the stage of complete degenerescence and therefore practically abandoned locally, although much better in quality and more drought-resistant than the third, which is now commonly grown in the region. This variety, distinguished by its white skin, tender flesh, and greater water requirements, was found in the course of experiments made at the Phytopathological Station in Rome, to be much more susceptible to attack by *R. solani* than the two former, more hardy varieties, the virulence of the infection appearing to be increased by copious watering alternating with periods when no water was supplied to the plants.

Plants grown under identical conditions but more regularly watered did not seem to suffer appreciably from the disease, although raised from heavily infected tubers.

On the still green haulms of the other two varieties at the end of September the author found numerous fructifications [illustrations of which are given] of the basidial stage of the fungus, which was identified as *Hypochnus* [*Corticium*] *solani*. The identity of this fungus with *Corticium vagum* is not accepted pending further investigations.

The drought is considered to have undoubtedly played a considerable part in the attack above mentioned. It is suggested that under conditions of drought the development of the fungus apart from its host is retarded, while the semi-moist tissues of the host offer a more favourable substratum. The more intense transpiration of the host, joined to the high osmotic pressure of the fungous tissues, may also be a factor in the causation of the disease, especially when transpiration is abruptly checked as during the night or by rain.

Notes are given on the control of the disease by cultural methods and the use of clean tubers.

HOWITT (J. E.). **Results of experiments to prevent Potato Rhizoctonia.**—Abs. in *Phytopath.*, xiv, 7, p. 349, 1924.

Experiments on the disinfection of the potato against *Rhizoctonia* [*solani*] have been carried out for five years at Guelph, Ontario. Solutions of mercuric chloride from 1 in 500 to 1 in 2,000 were used, the tubers being immersed for $\frac{1}{2}$ to 3 hours. The results showed that a solution of 1 in 500 for 1 or 2 hours eliminates *Rhizoctonia* under Ontario conditions.

AJREKAR (S. L.). **The problem of Potato storage in Western India.**—*Agric. Journ. India*, xix, 1, pp. 35–44, 1924.

The author reviews previous work on the decay of potatoes in storage in western India and discusses the results obtained since 1917 at the Poona Agricultural College, reserving the details of the experiments for separate publication.

The potato storage rots in western India, as distinct from injury by insects, comprise dry rots caused by fungi and wet rots caused by bacteria. As previously recorded [see this *Review*, iii, p. 419] the dry rots are caused by *Fusarium*, of which two species can cause rotting, and *Sclerotium* (*S. rolfsii* and a species formerly thought to be *Rhizoctonia solani* but now regarded as a species of *Sclerotium*). Subsequent invasion by bacteria may transform these into wet rots, especially at high temperatures (over 86° F.). The fungi will grow fairly well at temperatures between 77° and 95° F., and the bacteria have their optimum growth somewhere between 86° and 104°. Heat by itself cannot cause the storage rots prevalent in western India.

He believes that the problem of potato storage can be satisfactorily solved by comparatively simple precautions, namely: rigorous sorting, fumigation, rejection of all diseased and bruised tubers, careful storage in bags, and keeping down the temperature of storage below 90° F. with a view to checking the bacterial rots,

combined with improvements in the storage houses designed to reduce the temperature without increasing the moisture.

EDWARDES (J.). **Mould prevention on smoked sheet.**—*Bull. Rubber Growers' Assoc.*, vi, 2, pp. 83–86, 1924.

Preliminary tests having shown that para-nitro-phenol was effective as a fungicide at a concentration of 0·03 per cent., experiments were carried out to determine the mould preventing properties of this substance on smoked sheet rubber.

Freshly rolled sheet was soaked in the solution at 0·3 per cent. strength before smoking and was then inoculated by dusting with pieces of mouldy sheet. While the untreated controls and also rubber coagulated with sodium silico-fluoride [see this *Review*, ii, p. 427] showed varying degrees of mould growth after 31 or 32 days, none whatever developed on the sheet treated with para-nitro-phenol. These preliminary results are held to warrant further tests, including the effect of the treatment on vulcanization.

It is mentioned that the present routine treatment for mould prevention on Java rubber estates, which consists in soaking in water generally overnight before smoking, is less effective, longer, and more laborious than soaking the freshly rolled sheet for short periods in solutions of fungicides, especially in the case of the majority of estates in Malaya, where the sheet is rolled on the morning after coagulation, and where, therefore, a further prolongation of treatment before smoking would be undesirable.

DAVIS (W. H.). **Spore germination of Ustilago striaeformis.**—*Phytopath.*, xiv, 6, pp. 251–267, 2 pl., 1 fig., 1924.

This investigation was undertaken to determine the natural conditions under which spores of *Ustilago striaeformis* germinate and the nature of the germination (consequently the genus to which the fungus belongs) on red top (*Agrostis palustris*), timothy (*Phleum pratense*), June grass (*Poa pratensis*), and orchard grass (*Dactylis glomerata*).

Germination tests with a very large number of media showed that the age of the spore influenced the results and was a greater factor in promoting germination than the acidity of the solution employed. Favourable germination is not entirely dependent on the age of the infected green leaf, the kind of media, or intermittent freezing or thawing.

Tests showed that the smut spores must pass through an after-ripening period before germinating. The spores after-ripened best when stored in a damp atmosphere at about 20° C., low temperatures delaying the process. In the laboratory, after-ripening required about 240 days, in the field about 265 days. Smut spores taken from hosts grown in the greenhouse, and after-ripened at 20°, gave over 80 per cent. germination.

Fresh smut spores treated with chloroform fumes (1 minute) and citric acid (10 per cent. for 5 minutes) after-ripen and germinate three to four weeks earlier than untreated ones. Fresh spores incubated in 0·02 per cent. solutions of malic and citric acids gave sparse germination, and chemical treatment generally hastened the after-ripening process.

Good germination of after-ripened spores was consistently obtained by incubating the spores in water at 20° C.; moist filter paper, soil, and other surfaces were ineffectual unless sufficient moisture was present to cover them with a film of liquid.

The average minimum temperature for germination was 7° C., the optimum 22°, and the maximum 35°. The minimum and maximum temperatures, however, varied in the different hosts, notably in timothy, where the minimum was 12° and the maximum 37°.

Drying after-ripened spores for more than 7 days greatly decreased the viability.

In germination, the promycelia were at first unicellular and multinucleate, but under certain conditions became multicellular and bore four to five lateral sporidia. Typical sporidia, however, are rare. The granular protoplasm assembled in the tips of unicellular promycelia, which sometimes also formed lateral sporidia. The sporidia sometimes fuse. Budding may take place from the tips of promycelia, from primary sporidia, and sometimes even from the smut spore itself. The germinated spores failed to develop a saprophytic mycelium on agar or other media.

On the basis of the similarity of the germination to that of other species in the genus *Ustilago*, the author is of opinion that the fungus should be placed in this genus and not in *Tilletia* as has been done by some authors.

JOHNSON (M. O.). **Manganese chlorosis of Pineapples: its cause and control.**—*Hawaii Agric. Exper. Stat. Bull.* 52, 38 pp., 4 pl. (1 col.), 5 graphs, 1924.

Previous investigations on the effects of manganese [a review of which is given] are stated to furnish no conclusive proof of a stimulatory action on plant development due primarily to this element; nor is it considered to have been demonstrated in any of these researches that manganese causes a deficiency in the plant which may be remedied by the supply of iron. The author's studies [which are described in detail in the present paper] were accordingly directed to the elucidation of these problems, in their bearing on the so-called manganese chlorosis of the pineapple.

The manganese of the highly manganiferous Hawaiian soils was shown to be present mainly in the dioxide form. Hydrogen-ion determinations indicated that these soils are acid, and calcium carbonate is deficient.

A series of experiments was conducted with rice grown in nutrient solutions to determine the effect of manganous sulphate and manganese dioxide on growth where differing amounts of iron were supplied to the nutrient solution from various sources. When the nutrient solution contained only a normal amount of iron, both compounds induced a severe chlorosis and depression in growth. These effects, which were shown to be due to a depression in the assimilation of iron or to a deficiency of iron in the plant, were overcome when the leaves were dipped in solutions of iron salts or the amount of iron in the nutrient solution was very largely increased.

Manganese-induced chlorosis is altogether distinct from that due

to an excess of calcium carbonate, the former occurring primarily under acid conditions. Manganese and calcium carbonate can each produce an additive chlorotic effect in the presence of one another.

No evidence was secured in support of the view that manganese exerts a stimulatory effect on plant growth, though an increase in development may follow the elimination of excessive amounts of iron by manganese dioxide.

A description is given of field experiments in which solutions of iron salts were applied to the leaves of pineapple plants suffering from the toxic effects of the manganiferous Hawaiian soils, with the result that normal growth was completely restored. The treatment has been widely adopted and is now in regular use on more than half the Hawaiian pineapple fields.

Serious nature of Cane diseases. An Australian example.—*South African Sugar Journ.*, viii, 7, p. 535, 1924.

Attention is drawn to a statement by Mr. North, plant pathologist to the Colonial Sugar Refining Company, that on the Richmond River in New South Wales, the area infected with the gumming disease of sugar-cane has nearly doubled itself each year, reaching a total of 2,400 acres in 1923. It is now impossible to obtain sufficient healthy seedlings for planting in this district. The estimated loss in 1923 from 7 fields (22 acres) which were not worth harvesting was 475 tons of cane, and from another severely affected area, 2,611 tons. The cane sent for milling from the affected areas was seriously reduced in quality, the estimated loss to the grower from this cause being 11*s.* 7*d.* per ton in 1923.

Menace of streak disease. Need for selected plant Cane.—*South African Sugar Journ.*, viii, 8, p. 549, 1924.

Mr. H. H. Dodds, Director of the Experiment Station, Natal, has issued an official *communiqué* requesting that, in view of the serious menace of streak disease [see this *Review*, iii, pp. 685, 686] to the sugar industry, only selected disease-free seed be used for planting during the coming season. Planters having a surplus of healthy or lightly infected (under 5 per cent.) cane are asked to apply to the Government Mycologist for certificates of suitability for planting, while growers requiring seed for planting are urgently requested to purchase only such certified cane.

ARNAUD (G. and Mme.). **Trois Ascochyta nouveaux ou peu connus.** [Three new or little-known species of *Ascochyta*.]—*Rev. Path. Vég. et Ent. Agric.*, xi, 1, pp. 56–59, 1924.

The three species of *Ascochyta* briefly described in this note, namely *A. caricae* Rab. (non Pat.) on the fig, *A. syringae* Bres. on the lilac (*Syringa vulgaris*), and *A. hydrangeae* sp. n. on *Hydrangea hortorum* [diagnosis in French] have one character in common, namely, that their fructifications do not appear as black dots on the diseased spots on the leaves. They can best be seen by examining the leaves by transmitted light, when they appear as small, light-coloured, rounded spots, somewhat resembling the oil glands of certain leaves (e.g., *Hypericum*). The structure of the fructifications is similar in all the three species.

DOIDGE (ETHEL M.). **A preliminary check list of plant diseases occurring in South Africa.**—*Botanical Survey of South Africa Mem.* 6, 56 pp., 1924.

The present list of plant diseases known to occur in South Africa is the outcome of a decision taken at a conference of botanists at Pretoria in March 1923, and was compiled from the records of the Division of Botany (Department of Agriculture) and of the various Agricultural Schools in the Union.

The diseases (the popular names of which are given together with, when known, the name of the causal organism) are arranged according to their hosts, and in each case the localities and dates of record are given. In some cases very brief descriptions of the symptoms and damage caused are included. The list is, according to the author, far from complete and is only intended as a basis for further work in the preparation of a complete plant disease survey.

BAEZ (J. R.). **Criptogamas parásitas de las plantas cultivadas observadas en la región sud de la provincia de Córdoba.** [Cryptogams parasitic on cultivated plants, recorded in the southern zone of the province of Cordoba.]—*Min. Agric. Nac. (Buenos Aires), Secc. Prop. e Inform. Circ.* 216, 32 pp., 24 figs., 1924.

This is the second contribution by the author to the knowledge of the bacterial and fungal flora parasitic on cultivated plants in the Argentine, and includes the diseases recorded to the south of the town of Cordoba, arranged by genera of the causal organisms. Certain of the 104 species listed are new records for the country, while in a good many cases only the genus of the parasite is named.

GARBOWSKI (L.). **Les micromycètes de la Crimée et des districts limitrophes de la Russie méridionale en considération spéciale des parasites des arbres et des arbrisseaux fruitiers.** [The micromycetes of the Crimea and neighbouring districts of south Russia, with special reference to the parasites of fruit trees and shrubs.]—*Bull. Soc. Myc. de France,* xxxix, 4, pp. 227–260, 2 pl., 3 figs., 1924.

The present paper contains a list of 311 species of fungi collected in various localities of the Crimea in 1916 and 1917, including 23 new species and 5 new varieties. In each case the hosts, localities, and dates of collection are given.

Among numerous items of interest the following may be mentioned.

Tilletia levis is stated to be the most widely distributed species of bunt on wheat in the Crimea.

Sphaerotheca pannosa on the peach. The observation was made that the species of peach most resistant to leaf curl (*Exoascus deformans*) were most susceptible to mildew (*S. pannosa*). The author does not accept Woronchin's proposal to distinguish two varieties of the fungus, namely, *S. pannosa* var. *persicae* on the peach (perithecia measuring from 70 to 100 μ in diameter, asci 70 to 100 by 55 to 75 μ, and spores 22 to 25 by 14 to 15·6 μ), and var.

rosae on the rose (perithecia 94 to 125 μ in diameter, asci 94 to 124 by 70 to 78 μ, and spores 25 to 30 by 15·6 to 17 μ), since he found these distinctions were not constant.

Guignardia (*Laestadia*) *bidwellii* (imperfect stage *Phoma uvicola* Berk. et Curt.). In 1916 this fungus was found at the end of April attacking the base of one-year-old shoots, a localization said not to have been previously reported. The attack at this site results in the death of the shoot above and in the delayed development of the fruiting buds at its base so that the fruit has not time to ripen. The losses arising from this may sometimes be as high as 50 to 75 per cent. of the yield.

Hadrotrichum populi Sacc. on the apple, pear (leaves), plum, *Populus nigra*, and *Sorbus aria*. In the Crimea this fungus is of considerable economic importance on account of the damage it causes to fruit trees, especially the apple. On several varieties of the latter in the gardens of the Pomological Station [Aloushta, Crimea], it was found not only on the leaves, but also on the fruit, on which it formed rounded, whitish spots up to 1 cm. in diameter, surrounded by a reddish-brown margin and bearing black dots consisting of tufts of conidiophores which break through the dead epidermis. These spots are very like those caused by *Phoma pomorum* [a fungus which is not recorded in the present list] and the author believes that the damage done by *H. populi* is frequently ascribed to *P. pomorum*.

Cladosporium cucumerinum on cucumber fruits (*Cucumis sativus*). A brief description is given of a severe attack by this fungus at the Pomological Station, together with some details of its morphological characters.

Westerdijk (Johanna) & Van Luijk (A.). **Untersuchungen über Nectria coccinea (Pers.) Fr. und Nectria galligena Bres.** [Investigations on *Nectria coccinea* (Pers.) Fr. and *Nectria galligena* Bres.]—*Meded. Phytopath. Lab. 'Willie Commelin Scholten', Baarn (Holland)*, vi, pp. 3–30, 3 figs., 5 graphs, 1924.

This is a more detailed account of the comparative investigations on *Nectria coccinea* and *N. galligena*, a preliminary note on which has already appeared [see this *Review*, iii, p. 429]. The differences in the conidial and ascosporal dimensions in the two fungi from various hosts and from cultures are indicated by means of graphs. An exhaustive comparison, by biometrical methods, of the ascospore measurements is stated to be essential to the differentiation of these two species of *Nectria*, the characters of the perithecial wall and of the conidia being too variable to afford a reliable criterion in this respect. Although individual strains of these fungi vary greatly in morphological and biological characters, the differences are not regarded as sufficient to justify the creation of distinct biologic forms.

Palm (B. T.). **De stand van het slijmziekte-vraagstuk in de Deli-Tabak.** [The status of the slime disease problem in Deli Tobacco.]—*Meded. Deli Proefstat. te Medan-Sumatra*, Ser. 2, xxxii, 20 pp., 1 pl., 2 diag., 1924.

The author reviews, in general terms, the results of the investiga-

tions of slime disease of tobacco (*Bacterium solanacearum*) conducted at the Deli Experiment Station since 1920. These results have been published from time to time in papers which have been noticed in this *Review*. The phases of the problem considered in the present paper include the factors governing the pathogenicity of the causal organism and the control of the disease by disinfectants, the use of resistant varieties, cultural measures, and the cultivation of non-susceptible green manures, especially *Mimosa invisa* [see this *Review*, iii, p. 559, and next abstract].

PALM (B. T.) & FULMEK (L.). **Ziekten en plagen van Mimosa invisa.** [Diseases and pests of *Mimosa invisa*.]—*Meded. Deli Proefstat. te Medan-Sumatra*, Ser. 2, xxxv, pp. 27–36, 1924.

Mention has already been made [see this *Review*, iii, p. 559, and preceding abstract] of the immunity of *Mimosa invisa*, grown as a cover crop and green manure for tobacco, from the attacks of *Bacterium solanacearum*. The only parasitic fungus found on *Mimosa* in the Deli tobacco fields is *Sclerotium rolfsii* [see this *Review*, i, p. 412], which produces desiccation and discoloration of the leaves and drooping of the branches. The portion of the stem just above soil-level is covered with a dense, white mycelium. All the affected parts of the plant suffer from a wet rot. The brown, spherical to pyriform sclerotia, 1 to 2 mm. in diameter, can usually be found on infected material after a few days, but occasionally the mycelium may be devoured by minute, orange-red larvae, and the detection of the fruit bodies is thereby impeded.

The fungus spreads through the soil from plant to plant by means of its mycelium, while the sclerotia serve to carry it over unfavourable periods and to induce fresh infections when the opportunity arises. The *Mimosa* strain of *S. rolfsii* was found to be capable of infecting tobacco under laboratory conditions and is likely to do the same in the field. The writers consider, however, that the risk of transmission of *S. rolfsii* from *Mimosa* to tobacco, though not to be underrated, should not preclude the use of the former as a green manure on a large scale. Under the existing 'mixed' conditions of vegetation the danger of the transmission of *S. rolfsii* to tobacco from one of the 21 economic crops, 4 green manures, 6 ornamental plants, and 7 weeds [a list of which is given] on which it has been found in Deli or elsewhere is at least equally great.

The remainder of the paper deals with insect pests.

VRIEND (J.). **Resistentie-selectie bij Deli-Tabak.** [Selection for resistance in Deli Tobacco.]—*Meded. Deli Proefstat. te Medan-Sumatra*, Ser. 2, xxxiii, 10 pp., 4 graphs, 1924.

The results of field experiments [the technique of which is described], carried out in 1922 to test the resistance of various selected strains of Deli tobacco to slime disease (*Bacterium solanacearum*), were not very promising except in respect of one strain, R. 12, in which the number of infected plants was only 39·2 per cent. after 75 days as compared with 81·8 per cent. in the controls from the ordinary seed-beds. Seed was taken from some of the healthy R. 12 plants and sown in the following season on another estate in

impose, if destined to be used for experimental purposes. Th will be submitted, at the expense and responsibility of the importe to such disinfection or fumigation as may be required by t Plant Quarantine Inspectors ; they may also be isolated in quara tine until evidence is available showing that no injurious insects parasitic fungi are present on them. Certificates of freedom fro fungi and insects issued in the country of origin shall not pr clude inspection on arrival. Plant materials found to be infect shall be returned to the point of origin or destroyed, at the optio of the importer, the cost in either case to be borne by him.

Plant materials offered for import must be free from sand, soil, earth, and all plant roots, rhizomes, tubers, &c., must be washed as to free them thoroughly from such sand, soil, or earth, an must be so certified by the duly authorized inspector of t country of origin. Bulbs and corms (but no other plant material are allowed to be imported packed in sand, soil, or earth certifi to have been sterilized or otherwise safeguarded in accordan with the methods prescribed by the Philippine Bureau of Agri culture.

Packing materials employed in connexion with importation nursery stocks and other plants and seeds are subject to approv by the Bureau of Agriculture for such use, and must not have bee previously used as packing or otherwise in connexion with livin plants ; except when used for corms and bulbs, they must be certifie free from sand, soil, or earth.

Fruits, vegetables, cereals, and other plant products designed f food purposes, or properly dried and poisoned botanical specimen when free from sand, soil, or earth, may be imported withou permit, but subject to the conditions specified above.

Persons who intend to export plant materials must submit the Bureau of Agriculture an application for inspection of suc materials. If the plants upon inspection are found to be free fro parasitic fungi and injurious insects, a certificate will be issued the exporter, to accompany the shipment. Under no condition wi certificates of freedom from diseases be given for plants rais among other plants which are badly diseased or infected by insect Certificates will not be issued for plant materials of certain speci of plants intended for shipment to a country into which the entrance is absolutely prohibited.

Plant materials entering through the post shall be inspect upon notification of the presence of such materials at the po office.

By administrative order No. 30 the importation of plants of t genus *Musa* or of any unmanufactured parts of such plants strictly prohibited, with a view to protect the abaca plant (*M. te tilis*) from the introduction of injurious insects and fungi know to exist abroad on related species.

Administrative orders Nos. 31, 32, 33, and 37 prohibit the in portation of coco-nut, sugar-cane, rice, and tobacco plants, respe tively, and of unmanufactured products of these plants, and rice seeds, in order to prevent the introduction of injurious insec and fungal diseases that do not yet exist on these crops in t Philippines.

Administrative order No. 35 prohibits the importation of any variety of pineapple (*Ananas sativa*) and of any manufactured products of pineapple in view of the danger of such imports not only to this crop but also to sugar-cane.

Administrative order No. 36 prohibits the importation of all genera and species of bamboo (family Bambusae) or of any unmanufactured parts thereof, in view of the existence in many countries of dangerous diseases, including bamboo smut (*Ustilago shiraiana*).

In the case of all the above prohibitions, small quantities may be imported as provided in the first paragraph under order No. 29 above, and must be kept under quarantine in isolation until they have been shown to be free from injurious insects and parasitic fungi.

Administrative order No. 38 declares the diseases generally known as abaca heart rot and root rot [see this *Review*, ii, p. 108, and iii, p. 38] to be dangerous plant diseases, and provides for inspection by the Director of Agriculture or his authorized agent of all abaca plants in any locality where there is an outbreak of the disease. All infected plants will be marked, and the owners, lessees, or persons in charge of the plantations must destroy them in the manner prescribed.

By Administrative order No. 39 the disease commonly known as coco-nut bud rot [*Phytophthora palmivora*] is declared to be a dangerous plant disease, and measures similar to those contained in order No. 38 are provided for its eradication.

Plant Protection Ordinance, 1924—Order.—*Official Gazette Govt. of Palestine*, 112, pp. 589–590, 1924.

By an order under Article 3 of the Plant Protection Ordinance, 1924, the entry into Palestine from Egypt of plants or parts of plants of the following species is prohibited: banana, pigeon pea [*Cajanus indicus*], carrot, cotton (living plants only), lady's fingers [*Hibiscus esculentus*], prickly pear [*Opuntia* spp.], mulberry (fruits only), guava [*Psidium guajava*], sweet sop [*Anona squamosa*], papaw [*Carica papaya*] (fruits only), citrus (fruits only), beans, quince (fruits only), vines, custard apple [*Anona reticulata*] (fruits only), fig (fruits only), tomato, pomegranate (fruits only), eggplant [*Solanum melongena*], and mango [*Mangifera indica*] (fruits only). Other plants (including nursery stock) may be imported from Egypt only if accompanied by a certificate of apparent freedom from disease or of fumigation.

As regards the importation of plant material from countries other than Egypt, nursery stock for propagation (including grafting and bud wood) shall be admitted only if accompanied by a certificate of the Department of Agriculture, or other recognized agricultural institution in the country of origin, of freedom from disease, and if found on inspection to be free from infection. Fruits, roots, tubers, seeds, and parts of living plants other than nursery stock shall be admitted on being found free from pests (other than those of common local occurrence which, at the discretion of a plant inspector, need not constitute a bar to entry).

impose, if destined to be used for experimental purposes. They will be submitted, at the expense and responsibility of the importer, to such disinfection or fumigation as may be required by the Plant Quarantine Inspectors; they may also be isolated in quarantine until evidence is available showing that no injurious insects or parasitic fungi are present on them. Certificates of freedom from fungi and insects issued in the country of origin shall not preclude inspection on arrival. Plant materials found to be infected shall be returned to the point of origin or destroyed, at the option of the importer, the cost in either case to be borne by him.

Plant materials offered for import must be free from sand, soil, or earth, and all plant roots, rhizomes, tubers, &c., must be washed so as to free them thoroughly from such sand, soil, or earth, and must be so certified by the duly authorized inspector of the country of origin. Bulbs and corms (but no other plant materials) are allowed to be imported packed in sand, soil, or earth certified to have been sterilized or otherwise safeguarded in accordance with the methods prescribed by the Philippine Bureau of Agriculture.

Packing materials employed in connexion with importation of nursery stocks and other plants and seeds are subject to approval by the Bureau of Agriculture for such use, and must not have been previously used as packing or otherwise in connexion with living plants; except when used for corms and bulbs, they must be certified free from sand, soil, or earth.

Fruits, vegetables, cereals, and other plant products designed for food purposes, or properly dried and poisoned botanical specimens, when free from sand, soil, or earth, may be imported without permit, but subject to the conditions specified above.

Persons who intend to export plant materials must submit to the Bureau of Agriculture an application for inspection of such materials. If the plants upon inspection are found to be free from parasitic fungi and injurious insects, a certificate will be issued to the exporter, to accompany the shipment. Under no condition will certificates of freedom from diseases be given for plants raised among other plants which are badly diseased or infected by insects. Certificates will not be issued for plant materials of certain species of plants intended for shipment to a country into which their entrance is absolutely prohibited.

Plant materials entering through the post shall be inspected upon notification of the presence of such materials at the post office.

By administrative order No. 30 the importation of plants of the genus *Musa* or of any unmanufactured parts of such plants is strictly prohibited, with a view to protect the abaca plant (*M. textilis*) from the introduction of injurious insects and fungi known to exist abroad on related species.

Administrative orders Nos. 31, 32, 33, and 37 prohibit the importation of coco-nut, sugar-cane, rice, and tobacco plants, respectively, and of unmanufactured products of these plants, and of rice seeds, in order to prevent the introduction of injurious insects and fungal diseases that do not yet exist on these crops in the Philippines.

Administrative order No. 35 prohibits the importation of any variety of pineapple (*Ananas sativa*) and of any manufactured products of pineapple in view of the danger of such imports not only to this crop but also to sugar-cane.

Administrative order No. 36 prohibits the importation of all genera and species of bamboo (family Bambusae) or of any unmanufactured parts thereof, in view of the existence in many countries of dangerous diseases, including bamboo smut (*Ustilago shiraiana*).

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Amendments to the Regulations under the Destructive Insect and Pest Act (Canada).—*Canada Gazette*, 19th April 1923, and *Dept. of Agric. Leaflets*, 1924.

On and from 8th April 1924 certain regulations under the Destructive Insects and Pest Act [see this *Review*, iii, p. 239] are revised. No. 3, framed as a safeguard against wart disease (*Synchytrium endobioticum*) and originally prohibiting the importation of potatoes from Europe, the Canary Islands, Newfoundland, St. Pierre and Miquelon, California, Pennsylvania, West Virginia, and Maryland, is amended to permit the importation of potatoes from the three last-named States if accompanied by a certificate from a State or Federal officer stating that they were grown outside any of the quarantined areas of these States and have been examined and found free from wart disease.

Regulations regarding the movement of diseased plants in South Africa.—No. 172, 1924, *Government Gazette*, 1410, 8th August 1924.

By virtue of section 14 (c) of the Agricultural Pests Act of 1911 [which gives power to prohibit or restrict the removal of any plant from one place to another within the Union of South Africa in order to prevent the spread of any insect pest or plant disease] the transport of the following is prohibited within the Union: any citrus plant infected with citrus canker (*Bacterium citri*); and any fruit- or nut-bearing plant or any rose infected, or suspected of infestation, by crown gall (*Bact. tumefaciens*).

Union of South Africa. Act to amend further the Agricultural Pests Act, 1911 (Act No. 11 of 1911). No. 6, 1924.

This Act (which may be cited as the Agricultural Pests Further Amendment Act, 1924) provides for the inclusion of dead portions or products of plants in the definition of the word 'plant' in section 2 of the principal Act [see *Journ. Dept. Agric. S. Africa*, v, 4, p. 351, 1922]. Section 9 of the principal Act, restricting the importation of plants into the Union, is amended in such a way that herbaceous plants are only to be deemed plants within the meaning of the Act when a special declaration is made to that effect. Section 14 [see preceding abstract] is made to include dead portions or products of plants.

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